FINAL
SECOND INSTALLATION-WIDE FIVE-YEAR REVIEW REPORT
JOINT BASE LEWIS-MCCHORD
PIERCE COUNTY, WASHINGTON

SEPTEMBER 2017

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JOINT BASE LEWIS-MCCHORD
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Approved by:

Nicole M. Lucas
Colonel, US Army
Commanding

14 Nov 17
Date

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List of Acronyms

List of Acronyms and Abbreviations

§	Section
µg/L	micrograms per liter
1,1-DCE	1,1-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
AEDB-R	Army Environmental Database-Restoration
AFB	Air Force Base
AFFF	Aqueous Film Forming Foam
ALGT	American Lake Garden Tract
AR	Army Regulation
ARAR	Applicable or Relevant and Appropriate Requirement
AS	air sparging
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CENWK	Unites States Army Corps of Engineers, Kansas City District
cis-DCE	*cis*-1,2-dichloroethene
COC	contaminant of concern
CX	USACE Center of Expertise
DD	Decision Document
DoD	Department of Defense
DRMO	Defense Reutilization and Marketing Office
Ecology	Washington State Department of Ecology
EGDY	East Gate Disposal Yard (also known as Landfill 2)
EMCX	Environmental and Munitions Center of Expertise
EOD	Explosive Ordnance Disposal
ERA	ecological risk assessment
ERP	environmental restoration program
ESTCP	Environmental Security Technology Certification Program
ESD	Explanation of Significant Differences
FFA	Federal Facility Agreement
FS	Feasibility Study
ft	feet
FTLE	AEDB-R site naming convention for former Fort Lewis IRP sites
FYR	Five-Year Review
GAC	granular activated carbon
GIS	Geographic Information System
gpm	gallons per minute
GPT	groundwater pump and treat

List of Acronyms and Abbreviations

HHRA	Human Health Risk Assessment
HHSLRA	Human Health Screening Level Risk Assessment
HI	Hazard Index
IC	institutional control
IRP	Installation Restoration Program
IWTP	Industrial Wastewater Treatment Plant
JBLM	Joint Base Lewis McChord
Lewis-Main	Former Fort Lewis Army Base
LF	landfill
LOC	level of concern
LTM	long-term monitoring
LUC	land use control
LUCP	Land Use Control Plan
MAMC	Madigan Army Medical Center
McChord Field	Former McChord Air Force Base
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
MNA	monitored natural attenuation
MTCA	Model Toxics Control Act
MW	monitoring well
NCP	National Contingency Plan
NFA	No Further Action
NPL	National Priorities List
O&M	operations and maintenance
P&T	pump and treat
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PFASs	perfluorinated alkylated substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PNNL	Battelle's Pacific Northwest National Laboratory
PQL	practical quantitation limit
PRG	Preliminary Remedial Goal
RA	Response Action
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFA	RCRA Facility Assessment

List of Acronyms and Abbreviations

RG	Remediation Goal
RI	Remedial Investigation
ROD	Record of Decision
RSE	Remedial System Evaluation
RSL	Regional Screening Level
SLA	Sea Level Aquifer
SI	Site Investigation
SMIS	Site Management Investigation Study
SRCPP	Solvent Refined Coal Pilot Plant
STF	shear thinning fluid
SVE	soil vapor extraction
SVOCs	semi-volatile organic compounds
TCE	trichloroethene
TOC	total organic carbon
µg/L	micrograms per liter
USACE	Unites States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
UU/UE	unlimited use and unrestricted exposure
VC	vinyl chloride
VI	vapor intrusion
VISL	vapor intrusion screening level
VOC	volatile organic compound
WDOH	Washington Department of Health
WSP	Water System Plan
WTA	Washrack Treatment Area
ZVI	zero-valent iron

Executive Summary

The United States Army Corps of Engineers (USACE) – Kansas City District conducted this second installation-wide Five-Year Review (FYR) for Joint Base Lewis-McChord (JBLM) to evaluate if remedies selected for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites are and will continue to be protective of human health and the environment.

This FYR was prepared pursuant to the CERCLA § 121 consistent with the National Contingency Plan (NCP) 40 CFR Section 300.430(f)(4)(ii), and Executive Order 12580.

The trigger for the five-year review process was the start of remedial action construction at the Logistics Center in 1992. Sequentially, this FYR also serves as the fifth FYR for sites at both the former Fort Lewis Army Base (Lewis-Main) and the former McChord Air Force Base (McChord Field). These two installations are located in western central Washington and were combined as a joint base in February 2010 to form JBLM. The FYR for Lewis and McChord were first combined in 2012, thus this represents the second installation-wide FYR.

The following three Operable Units (OU) and the sites within each OU (**Table ES-1**) have been included in this FYR because they have signed Records of Decision (RODs) or Decision Document (DDs) and conditions that do not allow for unlimited use and unrestricted exposure (UU/UE) as of September 2016. No new sites have been added since the previous FYR. The site name and site ID [Army Environmental Data Base for the DoD Restoration program identifier (AEDB-R)] is included as a cross reference for Army tracking purposes.

Table ES-1: List of Operable Units Sites in Second Installation-Wide Five-Year Review

Operable Unit	Site / Site Group Name
OU1	OU1 - Logistics Center
	Logistics Center (FTLE-33)
	Illicit Polychlorinated Biphenyls Dump Site (FTLE-46)
	Landfill 1 (FTLE-54)
	Battery Acid Pit (FTLE-16)
	Defense Reutilization and Marketing Office Yard (FTLE-31)
	Industrial Wastewater Treatment Plant (FTLE-51)
	Pesticide Rinse Area (FTLE-28)
OU2	OU2 - Landfill 4 and Solvent Refined Coal Pilot Plant
	Landfill 4 (FTLE-57)
	Solvent Refined Coal Pilot Plant (FTLE-32)
OU3	OU3 - American Lake Garden Tract (MF-ALGT-LF-05)

FTLE: AEDB-R naming convention for the former Fort Lewis Installation Restoration Program sites
MF: AEDB-R naming convention for former McChord Field Installation Restoration Program sites

The major components of the selected remedy for OU1 - Logistics Center include three groundwater pump and treat (P&T) systems, source reduction actions (drum removal and in-situ thermal treatment), long-term groundwater monitoring (LTM), and land use controls (LUCs). OU3 - American Lake Garden Tract (ALGT) also utilizes a P&T system to remediate a separate groundwater plume in conjunction with LTM and LUCs; however, this P&T system was recently shutdown (2016) to evaluate remaining mass. Long-term monitoring and LUCs are the primary remedial components for the remaining CERCLA sites within the three OUs. For all OUs, LUCs enforced by the Army, such as access restrictions, land use restrictions, groundwater use restrictions and soil disturbance procedures have remained active and effective in protecting human health and the environment.

The pump and treat components of the OU1 - Logistics Center and OU3 - ALGT remedies have the potential to intercept groundwater containing perfluorinated alkylated substances (PFASs), an emerging contaminant recently identified within JBLM's water supply wells. If PFASs are present, the Logistics Center and ALGT treatment systems may not be configured to sufficiently treat prior to reinjection or beneficial reuse of extracted water. The presence of PFASs at these sites, whether as a result of historical site activities or broader, installation-wide PFASs contamination, has not yet been evaluated. Therefore, a protectiveness determination cannot be made at these sites until further information is obtained. Further information will be obtained by investigating and evaluating the presence of PFASs within the three pump and treat systems at the Logistics Center (OU1) and within the GPT system at the ALGT (OU3). It is expected that these actions will take approximately three years to complete, at which time a protectiveness determination will be made.

Additionally, in order for the remedy to be protective in the long-term, the Landfill 2 P&T system should be evaluated to determine whether it is providing complete capture of the plume in accordance with the RAOs through monitoring and capture zone analysis. If capture zone analysis shows lack of capture, pumping should be increased (through additional extraction well(s) and/or increased pumping).

The remedy for the OU2 site, Solvent Refined Coal Pilot Plant (SRCPP), currently protects human health and the environment because current land use is commercial, and the Lewis-Main Master Plan identifies the SRCPP's future land use as commercial. However, in order for the remedy to be protective in the long-term, institutional controls (ICs) are needed to restrict residential development and land use.

The remedies for the remaining sites that fall under OU1: Illicit PCB Dump Site, Landfill 1, Battery Acid Pit, DRMO Yard, Industrial Waste Water Treatment Plant, and Pesticide Rinse Area and OU2: Landfill 4 are protective of human health and the environment.

Additional information pertaining to remedial actions, progress since the last FYR process, technical assessments, issues and discussions, recommendations, and protectiveness statements are presented under each OU starting in **Section 5.0** of this document.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Joint Base Lewis-McChord (JBLM)		
EPA ID: WA9214053465		
Region: 10	State: WA	**City/County:** Pierce and Thurston
SITE STATUS		
NPL Status: Final		
Multiple OUs* Yes	Has the site achieved construction completion? Yes	
REVIEW STATUS		
Lead agency: Other Federal Agency: Department of Army		
Author name (Federal or State Project Manager): Meseret Ghebresllassie, Project Manager		
Author affiliation: Department of Army		
Review period: 09/2016 – 09/2017		
Date of site inspection: 7-8 September 2016		
Type of review: Statutory		
Review number: 5 (Second Installation-wide)		
Triggering action date: September 28, 2012		
Due date (five years after triggering action date): September 28, 2017		

*OU = operable unit

<table>
<tr><th colspan="5">Issues and Recommendations Identified in the Five-Year Review:</th></tr>
<tr><td colspan="5">OU1 - Logistics Center</td></tr>
<tr><td rowspan="3">OU1 - Logistics Center</td><td colspan="4">Issue Category: Changed Site Conditions</td></tr>
<tr><td colspan="4">Issue: Groundwater extraction and treatment systems may be intercepting groundwater containing PFASs. If present, reinjection may be redistributing PFASs, in some cases, in areas near the JBLM boundary.</td></tr>
<tr><td colspan="4">Recommendation: Evaluate presence of PFASs at the Logistics Center through collection of water samples at Landfill 2 and the influent and effluent at three pump and treat systems (LF-2, I-5, and SLA).</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>TBD</td><td>TBD</td><td>U.S. Army</td><td>EPA</td><td>September 2020</td></tr>
<tr><td rowspan="3">OU1 - Logistics Center</td><td colspan="4">Issue Category: Remedy Performance</td></tr>
<tr><td colspan="4">Issue: System capture may not be complete and contaminants may be migrating beyond the Landfill 2 capture zone. Further information is needed to evaluate the Landfill 2 groundwater extraction and treatment system’s capability to capture the TCE emanating from the Landfill.</td></tr>
<tr><td colspan="4">Recommendation: Evaluate if the system is providing complete capture of the plume in accordance with the RAOs through monitoring and capture zone analysis. The evaluation strategy could include installation of additional wells downgradient of the wells of concern, capture zone analysis, and rehabilitation or replacement of PW-1.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>No</td><td>Yes</td><td>U.S. Army</td><td>EPA</td><td>September 2019</td></tr>
<tr><td colspan="5">OU2 – Landfill 4 and Solvent Refined Coal Pilot Plant (SRCPP)</td></tr>
<tr><td rowspan="3">OU2 - SRCPP</td><td colspan="4">Issue Category: Institutional Controls</td></tr>
<tr><td colspan="4">Issue: Residual soil contamination does not allow residential land use. The 2017 JBLM LUC Plan does not restrict residential land use at SRCPP.</td></tr>
<tr><td colspan="4">Recommendation: Incorporate prevention of residential land use / development into the JBLM LUC Plan and annual inspection checklists.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>No</td><td>Yes</td><td>U.S. Army</td><td>EPA</td><td>September 2019</td></tr>
<tr><td colspan="5">OU3 - American Lake Garden Tract (ALGT)</td></tr>
<tr><td>OU3 - ALGT</td><td colspan="4">Issue Category: Changed Site Conditions</td></tr>
</table>

	Issue: Groundwater extraction and treatment system (currently shutdown) has the potential to intercept groundwater containing PFASs. If present, reinjection may be redistributing PFASs.			
	Recommendation: Evaluate presence of PFASs at ALGT through collection of groundwater samples from three wells within the footprint of the groundwater plume including one near the infiltration trenches. If operation of the ALGT GPT system is resumed, then samples from the influent and effluent should assessed for PFASs.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
TBD	TBD	U.S. Army	EPA	September 2020

Protectiveness Statement	
Operable Unit: OU1 - Logistics Center	Protectiveness Determination: Protectiveness Deferred

Protectiveness Statement:
A protectiveness determination for the OU1 – Logistics Center Remedy cannot be made at this time until further information is obtained. Further information will be obtained by taking the following action: an investigation and evaluation of the presence of PFASs within the three pump and treat systems at the Logistics Center. It is expected that this action will take approximately three years to complete, at which time a protectiveness determination will be made.

The following elements of the remedy have ensured that RAOs are being met. LUCs prevent exposure to groundwater by restricting installation of new drinking water wells within the areal extent of the TCE groundwater plume inside the JBLM boundary. Existing LUCs are preventing exposure to soil by maintaining a fence with signs around the perimeter of LF-2 and restricting training activities and unauthorized digging and construction within LF-2. LUCs are preventing exposure by preventing residential land use at LF-2 or within the 100 ug/L groundwater isoconcentration contour. The I-5 and SLA P&T systems prevent migration of contaminated groundwater within the Upper Vashon, Lower Vashon, and SLA.

Additionally, in order for the remedy to be protective in the long-term, the following action needs to be taken to ensure protectiveness: a thorough evaluation of whether the LF-2 system is providing complete capture of the plume in accordance with the RAOs through monitoring and capture zone analysis. If capture zone analysis shows lack of capture, pumping should be increased (through additional extraction well(s) and/or increased pumping).

At the Illicit PCB Dump Site, LUCs prevent exposure to contaminated soils by maintaining a fence with signs warning against unauthorized excavation and digging, restricting access, and ensuring the site is not used for training or residential land use. Maintenance of the cap also restricts exposure to contaminated soils.

At Landfill 1, LUCs are preventing exposure to groundwater and landfill wastes by restricting residential development, unplanned excavation, and installation of new drinking water wells within a 1,000 feet of the site boundary.

At the Battery Acid Pit, DRMO Yard, IWTP, and Pesticide Rinse Area, LUCs are preventing exposure to contaminated soils through maintenance of the asphalt cap and excavation and construction restrictions at the Battery Acid Pit and through prevention of residential land use at the Battery Acid Pit, DRMO Yard, IWTP, and the Pesticide Rinse Area.

Protectiveness Statement	
Operable Unit: OU2 - Landfill 4 and SRCPP	Protectiveness Determination: Protective

Protectiveness Statement:
The remedy at OU2 – LF-4 and SRCPP is currently protective of human health and the environment because:

- At LF-4, LUCs prevent exposure to contaminated groundwater by preventing installation of new drinking water wells within 1,000 ft of the site boundary. LUCs prevent exposure to landfill contents and contaminated soil by preventing residential land use, unplanned excavations, and off-road maneuvering within the site boundary.

- At SRCPP, LUCs prevent exposure to contaminated groundwater by restricting installation of new drinking water wells within the site boundary without an EPA approved monitoring plan. The site’s non-residential land use has prevented exposure to contaminated soils.

However, in order for the remedy to be protective in the long-term, the prevention of residential land use at SRCPP needs to be incorporated into the Final JBLM LUC Plan and annual inspection checklists to ensure protectiveness.

Protectiveness Statement	
Operable Unit: OU3 - ALGT	Protectiveness Determination: Protectiveness Deferred

Protectiveness Statement:
A protectiveness determination for the OU-3 – ALGT remedy cannot be made at this time until further information is obtained. Further information will be obtained by taking the following action: an investigation and evaluation of the presence of PFASs within the GPT system at the ALGT. It is expected that this action will take approximately three years to complete, at which time a protectiveness determination will be made.

Protectiveness Statement

Operable Unit: Site-wide	Protectiveness Determination: Protectiveness Deferred
Protectiveness Statement: The remedial action at OU2 currently protects human health and the environment. However, because a protectiveness determination of the remedies at OU1 and OU3 cannot be made at this time, the protectiveness determination for the site is deferred until further information is obtained. Further information will be obtained by investigating and evaluating the presence of PFASs within the three pump and treat systems at the Logistics Center (OU1) and within the GPT system at the ALGT (OU3). It is expected that these actions will take approximately three years to complete, at which time a protectiveness determination will be made. In addition, in order for the remedy at the SRCPP (OU2) to be protective in the long-term, the prevention of residential land use needs to be incorporated into the JBLM LUC Plan and annual inspection checklists to ensure protectiveness.	

1.0 Introduction

The purpose of the five-year review (FYR) is to evaluate the performance of the remedy and determine whether the remedy remains protective of human health and the environment and functions as intended based on the decision documents. Furthermore, the FYR assesses whether the remedy will continue to be protective in the future. It determines whether the exposure assumptions, toxicity data, cleanup levels and remedial action objectives (RAOs), used at the time of the remedy selection are still valid and whether any other information has come to light that could call into question the protectiveness of the remedy.

The FYR is a statutory requirement for Joint Base Lewis McChord (JBLM) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section (§) 121(c) and the National Contingency Plan (NCP). CERCLA § 121(c), as amended, states the following:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

In the NCP implementing regulations, 40 Code of Federal Regulations § 300.430(f)(4)(ii), the United States Environmental Protection Agency (USEPA) provided the following interpretation:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

The United States Army Corps of Engineers (USACE), under contract to the U.S. Army Environmental Command (USAEC), conducted the second installation-wide FYR of the remedial actions implemented at Joint Base Lewis McChord, located in Pierce County, Washington (**Figure 1-1**). While this is considered the second FYR for the JBLM installation, it is the fifth five-year review for both Lewis-Main and McChord Field.

This review was conducted from September 2016 through September 2017 by the USACE, Kansas City District. This report documents the results of that review. The triggering action for this statutory review is the date the USEPA concurred with the previous FYR which occurred on September 28, 2012. The FYR is required because hazardous substances, pollutants, or contaminants remain at the sites above levels that allow for unlimited use and unrestricted exposure (UU/UE). This FYR includes the review of site conditions and site data available through September 2016, and when available, includes validated data through 2016.

1.1 Sites Reviewed

The three operable units (OU) and the sites included in each OU are listed in **Table 1-1**. These operable units are included in this FYR because they have signed Records of Decision (RODs) or Decision Document (DDs) and conditions that do not allow for UU/UE as of September 2016. No new sites have been added since the previous FYR. Table 1-1 provides an overview of protectiveness determinations, includes the individual site name and site ID [Army Environmental Data Base for the DoD Restoration program identifier (AEDB-R)] for sites within each OU.

Table 1-1: Summary of Sites and Protectiveness Determinations

OU	Report Section	Site / Site Group Name	Protectiveness Determination		
			Short-term	Long-term	Deferred
1	**5.0**	**OU1 – Logistics Center**	**TBD**	**TBD**	**X**
	5.1	Logistics Center (FTLE-33)	--	--	--
	5.2	Illicit Polychlorinated Biphenyls Dump Site (FTLE-46)	--	--	--
	5.3	Landfill 1 (FTLE-54)	--	--	--
	5.4	Battery Acid Pit (FTLE-16)	--	--	--
	5.4	Defense Reutilization and Marketing Office Yard (FTLE-31)	--	--	--
	5.4	Industrial Wastewater Treatment Plant (FTLE-51)	--	--	--
	5.5	Pesticide Rinse Area (FTLE-28)	--	--	--
2	**6.0**	**OU2 – Landfill 4 and Solvent Refined Coal Pilot Plant**	**Yes**	**TBD**	**--**
	6.1	Landfill 4 (FTLE-57)	--	--	--
	6.2	Solvent Refined Coal Pilot Plant (FTLE-32)	--	--	--
3	**7.0**	**American Lake Garden Tract (MF-ALGT-LF-05)**	**TBD**	**TBD**	**X**

FTLE: AEDB-R naming convention for the former Fort Lewis IRP sites
MF: AEDB-R naming convention for former McChord Field IRP sites
TBD: to be determined

Table 1-2: Summary of CERCLA sites and Remedy Selection Documentation

OU	Site	Remedial Components	Regulatory Driver Documentation			
			Doc. Desc.	Doc. Date	Status	EPA Concur
OU1	Logistics Center	EGDY P&T	ROD	Sep-90	ROD sign.	Y
		I-5 P&T				
		GWM				
		LUCs (undefined)				
		Various minor items in ESD	ESD	Sep-98	ESD sign.	Y
		Drum Removal	DD	Jul-00	*	*
		In-Situ Thermal Treatment	DD	Apr-06	*	*
		LUCs (residential, excavation, training access, fence/signs) within LF boundary	LUC Plan	Sep-07	9/27/07 letter	Y
		No action for vapor intrusion other than LUC on residential LU within 100 ug/L	Final Report	Sep-07	9/26/07 letter	Y
	Illicit PCB Dump Site (non-NPL)	Cap Maintenance	DD	Apr-06	1/19/05 email	Y
		LUCs (residential, excavation, training access, fence/signs, cap) within site boundary				
	Landfill 1 (non-NPL)	GWM	DD	Apr-06	4/20/04 email	Y
		LUCs (residential, excavation) within LF boundary	LUC Plan	Sep-07	9/27/07 letter	Y
		LUCs (new water wells) within 1000' of LF boundary				
	Battery Acid Pit (non-NPL)	LUCS (residential, excavation, cap) within site boundary	DD	Apr-06	1/19/05 email	Y
	DRMO Yard (non-NPL)	LUCS (residential) within site boundary	DD	Apr-06	1/19/05 email	Y
	IWTP (non-NPL)	LUCS (residential) within site boundary	Draft DD	Dec-07	--	--
	Pesticide Rinse Area (non-NPL)	LUCS (residential) within site boundary	DD	Dec-00	1/7/00 letter	Y
OU2	SRCPP (NPL)	Ex-situ Soil Treatment	ROD	Sep-93	ROD sign.	Y
		GWM (no longer necessary)				
		LUCs (new water wells) w/in 1000' of site boundary				
	Landfill 4 (NPL)	AS/SVE	ROD	Sep-93	ROD sign.	Y
		GWM				

OU	Site	Remedial Components	Regulatory Driver Documentation			
			Doc. Desc.	Doc. Date	Status	EPA Concur
		LUCs (undefined)				
		LUCS (residential, excavation, training activities) w/in LF				
		LUCs (new water wells) w/in 1000' of site boundary	LUC Plan	Sep-07	9/27/07 letter	Y
OU3	ALGT (NPL)	P&T System				
		GWM				
		LUCs (undefined)	ROD	Sep-91	ROD sign.	Y
		LUCS (residential, excavation, training activities) w/in LF				
		LUCs (new water wells) w/in 1000' of LF boundaries or plume extent	LUC Plan	Aug-11	--	Y

ALGT: American Lake Garden Tract
AS/SVE: Air Sparge / Soil Vapor Extraction
EGDY: East Gate Disposal Yard (i.e., Landfill 2)
DRMO: Defense Reutilization and Marketing Office
GWM: Groundwater Monitoring
IWTP: Industrial Water Treatment Plant
LUC: Land Use Control
SRCPP: Solvent Refined Coal Pilot Plant
*As documented in the 2012 Five-Year Review

1.2 Sites Removed from the CERCLA FYR

As stated in the 2015 Preliminary Close Out Report (USEPA, 2015c), the following seven sites no longer require CERCLA FYRs:

- Stormwater Outfalls – FTLE-10
- Fire Training Pit – FTLE-17
- Park Marsh Landfill – FTLE-18
- Landfill 6 (LF 6) – FTLE-59
- Explosive Ordnance Disposal Site 62 (no AEDB-R designation)
- Well LC-6 & Pit Area (no AEDB-R designation)
- Landfill 5 (no AEDB-R designation)

While land use controls (LUCs) are no longer required under CERCLA for the sites listed above, the Army has retained LUCs on a portion of these sites to comply with State or Army requirements.

Additionally, as stated in the September 19, 1991 Record of Decision (ROD) for ALGT, the following ALGT subsites had soil contaminant concentrations that were determined not to pose an unacceptable risk to human health, welfare, or the environment and are not the source of TCE groundwater contamination.

- Landfill D4 (ALGT) – MF-LF-004
- Base Landfill D6 (ALGT) – MF-LF-006
- Radioactive Waste Disposal Well (ALGT) – MF-RW-035
- Ordnance Disposal – Burn Kettles, Military Munitions Response Program portion of site (ALGT) – MF-OT-026

Based on groundwater monitoring completed after the ROD, the following two ALGT subsites have achieved cleanup levels for TCE (Environmental Management Branch, 1991).

- Base Landfill D7 (ALGT) – MF-LF-007
- Concrete Burn Trench (ALGT) – MF-OT-039

Therefore, the six ALGT subsites listed above do not require CERCLA FYRs. The Army has retained LUCs on four of the above six sites (excluding MF-OT-026 and MF-RW-035) to comply with internal requirements; however, LUCs are not required under CERCLA for these subsites. JBLM environmental restoration managers indicated a report is being drafted in 2017 to formally document closure of the subsites above.

The following site was delisted from the NPL on September 26, 1996.

- Wash Rack/Treatment Area National Priorities List (NPL) Site (WTA) – composed of both MF-SD-054 and MF-DP-60.

LUCs have been placed on the WTA with additional long term monitoring (LTM) for site MF-SD-054 and MF-DP-60 due to remaining residual petroleum contamination regulated by Ecology. However, these sites do not require CERCLA FYRs.

1.3 Report Organization

Due to the number of individual sites addressed in this report, the report organization deviates from the FYR Report Guidance (USEPA, 2001) to provide a more readable document by summarizing installation-wide information upfront and site-specific information within individual sections. Required information has been grouped by site in order to present a complete review and provide recommendations in one place. The chart below presents the report organization according to FYR guidance and identifies where the appropriate information can be found in this report.

Guidance Organization	Five-Year Report Organization
1. Introduction	**Section 1.** Introduction Consistent with guidance
2. Site Chronology	**Section 2.** Installation-wide chronology. Specific chronology is included in individual sections.
3. Background -Site Location -Physical Characteristics	**Section 4.** Installation-wide Background and Land Use Controls

Guidance Organization	Five-Year Report Organization
-Land and Resource Use -History of Contamination -Initial Response -Basis for Taking Action	Summarizes installation-wide information and institutional controls applicable to entire Installation. Site-specific background are presented within individual sections.
4. Remedial Action -Remedy Selection -Remedy Implementation -System Operation/O&M	**Sections 5-7.** Individual OUs. Site-specific basis for taking action included.
5. Progress Since Last Review	**Sections 5-7.** Individual OUs
6. Five-Year Review Process -Review Team Members -Community Involvement -Document Review -Data Review -Site Inspections -Interviews	**Section 3. Five-Year Review Process** Each of the components listed under guidance is included in this section with the exception of: - Documents relevant to all sites listed in **Section 3**. - OU and site-specific documents listed in **Sections 5-7**. - Data Review is summarized within site-specific sections. - Where applicable, site-specific inspections and interviews may be discussed in more detail within **Sections 5-7**. - A discussion of the method used to evaluate the validity of previous human health risk assumptions is included within **Section 3**.
7. Technical Assessment -Question A -Question B -Question C	**Sections 5-7.** Individual site sections
8. Issues	**Sections 5-7.** Individual site sections
9. Recommendations and Follow-up Actions	**Sections 5-7.** Individual site sections
10. Protectiveness Statement	**Sections 5-7.** Individual site sections **Section 8**. Site-wide protectiveness statement.
11. Next Review	**Section 9.** Next Review
	Section 10. References

Under each Operable unit, a typical section is organized in the following manner:

1.0 Individual Section Organization (Sections 5-7)
1.1 Site Background: - Site Location - Physical Characteristics (if discussion beyond installation-wide description is merited) - Land and Resource Use (if different from installation-wide description) - History of Contamination - Site Chronology - Initial Response - Basis for Taking Action
1.2 Remedial Actions: - Remedy Selection - Remedy Implementation - System Operation/O&M
1.3 Progress Since Last Five-Year Review

1.4	**Document and Data Review** - Documents Reviewed - Data Review and Evaluation
1.5	**Technical Assessment** - Question A - Question B - Question C
1.6	**Issues**
1.7	**Recommendations and Follow-up Actions**
1.8	**Protectiveness Statement**

2.0 Site Chronology

Table 2-1 provides a chronological summary of significant environmental projects and milestones for JBLM. A site-specific chronology of events is included in individual sections

Table 2-1: JBLM Chronology

JBLM Projects and Milestones		Date
Former Fort Lewis	**Former McChord AFB**	
-	Disposal activities at the site.	mid-1940s to early 1970s
Soil removal at the SRCPP.	-	1980
-	Department of Defense Installation Restoration Program (IRP) initiated at McChord AFB.	1981
-	IRP Phase I—Records search.	1982
Illicit PCB Dump Site discovered followed by emergency removal action.	IRP Phase II—Site investigation. Discovery/Preliminary Assessment.	1983
	ALGT added to NPL	1984
-	Interim remedial activities—bottled water provided to private residences.	1984-86
Trichloroethylene (TCE) discovered in shallow groundwater beneath the Logistics Center.	-	1985
Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) completed.	Residences located within 5-micrograms per liter (μg/L) contour of the TCE plume connected to the public water system.	1986
Landfill 5 added to NPL	Wash Rack/Treatment Area added to NPL	1987
-	Remedial Investigation/Feasibility Study (RI/FS) negotiations completed.	1988
Logistics Center added to NPL	Federal Facilities Agreement (FFA) between Air Force, USEPA, and Washington State Department of Ecology (Ecology) finalized.	1989
FFA signed; Logistics Center ROD signed.	Human Health Risk Assessment (HHRA) finalized.	1990
-	-	

JBLM Projects and Milestones		Date
Former Fort Lewis	**Former McChord AFB**	
-	Ecological Risk Assessment finalized. RI/FS finalized; Proposed Plan identifying USEPA's preferred remedy presented to public; start of public comment period. ALGT ROD signed.	1991
Construction of two Logistics Center P&T systems in Vashon Aquifer begins.	Remedial Design completed.	1992
LF 4/SRCPP ROD signed and sites added as operable units to Logistics Center.	Began on-site construction of groundwater containment and treatment system. Completed connection of residents in the ALGT to the public water system.	1993
-	Containment system startup. Operations and Maintenance (O&M) Plan approved by USEPA. Completed on-site construction of groundwater containment and treatment system.	1994
Logistics Center Vashon Aquifer P&T systems begin operation.	-	1995
Landfill 5 deleted from NPL	-	1995
-	Wash Rack/Treatment Area deleted from NPL	1996
Low-temperature thermal desorption at SRCPP conducted.	-	1996 – 1997
Air sparging/soil vapor extraction at LF 4 conducted.	-	1996 – 1999
First FYR for Logistics Center.	-	1997
Logistics Center Explanation of Significant Difference (ESD) signed.	-	1998
-	Extraction well DX-1 shut down due to low concentrations in aquifer.	1999
DD for Logistics Center source area drum removal action signed.	First FYR completed.	2000
DD for Pesticide Rinse Area signed.	-	2000

JBLM Projects and Milestones		Date
Former Fort Lewis	**Former McChord AFB**	
Drum removal action at Logistics Center source area conducted.	-	2000 – 2001
DD for Logistics Center source area in-situ thermal treatment signed.	-	2002
Second FYR for Logistics Center, LF 4, & Illicit PCB Dump Site.	-	2002
Logistics Center source area Vashon Aquifer P&T system re-configured (Landfill 2 P&T).	Extraction well DX-2 shut down due to low concentrations in aquifer.	2003 – 2006
In-situ thermal treatment at Logistics Center source area conducted.	-	2003 – 2007
-	Extraction well DX-2 pump replaced and returned to service due to a monitoring well slightly above remediation goal.	2004
Sampling for 1,4-dioxane completed for Landfill 2 (formerly known as EGDY).	-	2004
	Second FYR completed. Sampling for 1,4-dioxane completed.	2005
DDs for Battery Acid Pit, Defense Reutilization and Marketing Office (DRMO) Yard, Illicit PCB Dump Site, LF 1, and LUCs at Logistics Center source area (Landfill 2 soil) signed.	-	2006
Optimization of downgradient Vashon Aquifer P&T system (Interstate 5 P&T).	-	2006 - present
No Further Action (NFA) DDs for LF 6 and Park Marsh Landfill signed.	-	2006
ESD for Logistics Center SLA signed.	-	2007
Indoor air sampling conducted at Madigan Housing.	-	2007
Draft DD for IWTP generated.	-	2007
Existing Land Use Controls (LUCs) formally documented in Land Use Control Plan (LUCP).	-	2007
Construction of Logistics Center P&T system in SLA begins.	-	2007

JBLM Projects and Milestones		**Date**
Former Fort Lewis	**Former McChord AFB**	
Third FYR completed	-	2007
Environmental Security Technology Certification Program (ESTCP) Cost and Performance Report – In-Situ Bioremediation of Chlorinated Solvents Source Areas with Enhanced Mass Transfer Start-up of the Sea Level Aquifer (SLA) P&T began in October	-	2009
-	Third FYR completed.	2010
JBLM: Tech Memo to formalize 1). NFA for Fire Training Pit and Park Marsh Landfill, and 2). remedial alternative selection for the Pesticides Rinse Area, Illicit PCB Dump, and LF 1 (LF1)		2010
JBLM: ESD for Logistics Center that includes the following sites; DRMO Yard, LF 6, IWTP, Battery Acid Pit, and Well LC-6 and Pit Area.		2010
JBLM: Remediation System Evaluation (RSE) completed by USACE Center of Expertise (CX).		2011
-	Existing LUCs formally documented in LUCP.	2011
First Installation-Wide Five Year Review Completed		2012
Draft 2014 JBLM Land Use Control Plan		2014
Preliminary Close Out Report – Logistics Center National Priorities List Site (documenting the US Army completed construction activities)		2015
-	Area D/ALGT groundwater pump and treat system temporarily shutdown to collect data for monitored natural attenuation evaluation.	2016
Second Installation-Wide Five Year Review Initiated		2016

3.0 Five-Year Review Process

3.1 Review Team Members

The fifth FYR effort included the following team members:

- Preparation by USACE Kansas City District (CENWK):
  - Erin Hauber, Engineer
  - Eric Gorman, Geologist
  - Brian Roberts, Engineer
  - Janet Mathews-Flynn, Hydrogeologist
  - Dave Daniel, Risk Assessor
- Support and/or review from:
  - JBLM, Ms. Meseret Ghebresllassie
  - USAEC, Mr. Robert Blaesing
  - USACE Environmental and Munitions Center of Expertise (EMCX)
  - USEPA Region 10, Mr. Christopher Cora
  - Department of Ecology Toxics Cleanup Program (Ecology), Dr. Ben Forson

3.2 Community Involvement

A newspaper notice was placed in The News Tribune and The Olympian on September 15, 2016 and September 14, 2016, respectively, to notify the community that the FYR process is underway. Verification of publication for these notifications and postings is included in **Appendix 3**. JBLM does not currently have a Restoration Advisory Board (RAB) but solicits the community for interest in a RAB every two years.

At the end of the FYR, a newspaper notice will be published to announce that the FYR report is available for public viewing. The completed FYR report will be available at two public locations: on-post at the Grandstaff Library and at the Lakewood Pierce County Library, 6300 Wildaire Rd SW, Lakewood, WA.

3.3 Site Inspection

A site inspection was conducted as part of this FYR on September 7th and 8th, 2016. The FYR team also attended the September Federal Facilities Agreement (FFA) meeting on September 8th, 2016 which included representatives from JBLM, USAEC, USEPA, Ecology, and remedial action operation (RAO) contractors Tetra Tech and Sealaska. The status of each of the sites and future activities was discussed. USACE FYR team was given an opportunity to ask questions and seek clarification during the meeting.

The site inspection included the following:

- Tom Lynott, representative for JBLM Environmental Restoration Program
- Erin Hauber, Engineer, CENWK
- Janet Mathews-Flynn, Hydrogeologist, CENWK

- Eric Gorman, Geologist, CENWK

The site inspection included a tour of JBLM and overview of the various environmental restoration programs. Each of the ten sites were inspected to determine if the land use was consistent with the selected remedy and the LUC objectives identified in the Draft 2016 JBLM LUC Plan, and if there were any visually apparent issues that may affect the remedy's protectiveness. Annual LUC inspection reports completed within this review period (i.e., 2012 through 2016) were reviewed for a more comprehensive understanding of whether LUCs were being maintained. The primary JBLM system operator, Robert Thomas from Sealaska, provided an overview of the Logistics Center's P&T systems (Area D and I-5) and the Sea Level Aquifer (SLA) system which is operated by Madigan Army Medical Center (MAMC). Findings associated with individual sites are discussed in their respective section. Site inspection observations that are not site-specific are noted below.

Administrative Record:

- Ensure the master administrative record is being maintained in accordance with CERCLA guidance[1]. Currently, the administrative hard-copy record is being stored in a building near Landfill 2 that is not climate controlled, and it was unclear whether boxes were appropriately labeled and indexed to allow updating and verification of the administrative record (see picture in **Appendix 3**).

- The FYR team visited the on-post Grandstaff library, one of the two locations that the administrative record is made available to the public. Given the infrequent public interest in viewing the administrative record, not all librarians were aware of the files and where they resided. While the library staff onsite was unable to locate the record during the team's visit, they knew who to contact at JBLM for further information. A brief inspection of an electronic version of the administrative record pertinent to the 10 CERCLA sites in this FYR indicated the administrative record was being maintained.

The FYR site inspection photo log is included in **Appendix 3**. During the site visit, JBLM staff responsible for maintaining, storing, and accessing the LUC data (e.g., extent of site boundaries, dig restrictions, land use restrictions, drinking water installation restrictions, etc.) were interviewed and provided a tour of the Geographic Information System (GIS) overlays and environmental protocols used to meet LUC objectives described in the Draft 2016 JBLM LUC Plan. The installation-wide LUC mechanisms are discussed in **Section 4.5**.

3.4 Site Interviews

During the site visit and FFA meeting, interviews and data gathering were conducted with JBLM staff, remedial action operation contractors Tetra Tech and Sealaska including system operators, Ecology, and USEPA Region 10. During the FFA meeting, USEPA requested that the FYR team evaluate the potential for perfluorooctane sulfonate and perfluorooctanoic acid (PFOS/PFOA) presence at CERCLA FYR sites (**Section 3.6.1**). Surveys, consistent in content with FYR guidance, were distributed to representatives from Ecology and USEPA via email as a follow-up to FFA meeting. No additional

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[1] *Revised Guidance on Compiling Administrative Records for CERCLA Response Actions. September 2010 and March 2013 revision re: permitted use of technology to share admin record with public*

feedback was provided to the FYR team based on these surveys or follow-up phone calls, and no other issues or concerns pertaining to protectiveness were identified by interviewees.

3.5 Document Review

This FYR included a review of relevant information contained in a variety of site-related documents. The information review primarily focused on documents produced within the last FYR period or after September 2012, but in some cases included additional background documents. In general, common documents reviewed included:

- ROD or DD
- RD / Remedial Action Work Plan (RAWP)
- Annual Operation and Maintenance (O&M) or Groundwater Monitoring reports
- Annual LUC inspection checklists
- 2017 Final Comprehensive JBLM LUC Plan
- Validated 2016 data and draft 2016 annual reports, and technical memoranda, when available

Due to the site-specific nature of most documents, sections dedicated to individual sites include a list of documents reviewed. However, the following is a list of documents and references common to multiple sites:

JBLM, 2006. Real Property Master Planning for Army Installations. May.

JBLM, 2012a. JBLM CERCLA LUC Checklist. January.

JBLM, 2012b. JBLM CERCLA LUC Checklist. December.

JBLM, 2013. JBLM CERCLA LUC Checklist. December.

JBLM, 2014. JBLM CERCLA LUC Checklist. November.

JBLM, 2016. JBLM CERCLA LUC Checklist. January.

United States Army Corps of Engineers, 2012. First Installation-Wide Five-Year Review, JBLM. September.

Public Works, 2011. Land Use Control Plan, Joint Base Lewis-McChord – McChord Field American Lake Garden Tract CERCLA Site. August.

Public Works, 2016. Draft Comprehensive Land Use Controls Plan, Joint Base Lewis-McChord. December.

Versar, 2016. Draft Comprehensive Land Use Controls Plan, Joint Base Lewis-McChord. January.

Versar, 2017. Final Comprehensive Land Use Controls Plan, Joint Base Lewis-McChord. May.

United States Environmental Protection Agency, 2015. Preliminary Close Out Report Joint Base Lewis McChord Logistics Center National Priorities List Site. September.

3.6 Risk Evaluation – Process for Evaluating FYR Question B

Each section includes an individual assessment of Question B from the Technical Assessment, below; however, the process is described here to avoid repetition.

> *Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?*

In general, there have been changes to risk assessment methods, exposure assumptions, and toxicity factors since the original risk assessments, screening level evaluations and remediation goals (RGs) were established. These general changes are summarized in **Appendix 5**. The evaluation of whether these changes result in an unacceptable risk was made by comparing RGs to the USEPA Regional Screening Level (RSL), which uses current equations, exposure factors, and toxicity values (USEPA, 2016). Typically, RSLs are used in the data screening phase of a baseline human health risk assessment (HHRA) to determine what chemicals in various environmental media at a site potentially warrant further investigation or site cleanup. If a chemical concentration in soil or groundwater does not exceed its respective RSL, that chemical would not typically pose an unacceptable human health risk to the potential receptors. If a chemical concentration does exceed its respective RSL, it wouldn't necessarily pose an unacceptable risk, but typically warrants further evaluation.

Table 3-1 summarizes the RGs for contaminants of concern (COCs) at all JBLM sites included in this FYR. It lists the RG's original basis (e.g., maximum contaminant level, Ecology's Model Toxics Control Act [MTCA]), the updated Applicable or Relevant and Appropriate Requirements (ARARs) (e.g., most recent value for that ARAR), and the applicable RSL. Finally, the corresponding risks associated with the RG, including both cancer and non-cancer, were calculated using the most recent RSL calculator. In a few instances, the calculated risk level was outside the acceptable range and further analysis was performed to determine impact on the protectiveness of the remedy.

The site land use was reviewed to determine whether exposure assumptions have changed since remedy selection and RAOs evaluated to determine whether they continue to protect potential receptors.

Finally, the likelihood of emerging contaminants being present at the site was considered. In 2004 and 2005, samples collected from ALGT and Logistics center were analyzed for 1,4-dioxane and found to be below detection limits or 5 µg/L, the MTCA Method B cleanup standard for 1,4-dioxane at the time. The risk level associated with 5 µg/L was calculated and found to be within acceptable limits, as described in applicable sections. Perfluorinated alkylated substances (PFASs) are discussed below.

3.6.1 Perfluorinated Alkylated Substances (PFASs) Monitoring

Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS) are manufactured fluorinated organic chemicals and emerging contaminants. In May 2016, the USEPA issued a Lifetime Health Advisory (LHA) level in drinking water of 70 parts per trillion (ppt) for PFOS/PFOA (applying to individual or combination of PFOS and PFOA). These compounds have been used in carpets, clothing, furniture fabric, paper packaging for food, and other materials (e.g., cookware) that is resistant to water, grease or stains. The Army's primary known source of PFOS and PFOA is from the use of Aqueous

Film Forming Foam (AFFF) for fire suppression, particularly AFFF containing PFOS, used by industry and Department of Defense (DoD) since 1970 to fight petroleum fires. AFFF was used for firefighter training at several locations on the east side of McChord Field's runaway and on Lewis Main's Gray Army Airfield through the early 1990s. The Department of Defense (DoD) used AFFF to extinguish petroleum based fires in response actions, fire training activities, and in fire suppression systems. Some metal plating operations used PFOS-containing mist suppressants. AFFF was developed by the Navy and the Minnesota Mining and Manufacturing Co., now 3M, in the 1960s; however, only facilities that performed these activities and remained under DoD jurisdiction after 1970 were likely to have used and stored AFFF. For the purposes of this report, PFOS and PFOA compounds will be referred to jointly as perfluorinated alkylated substances or PFASs.

3.6.1.1 JBLM Water Supply Well PFASs Sampling

In accordance with recent Army guidance, JBLM conducted an initial sampling of some of the installation's 23 permitted water supply wells in April 2016 shortly before the EPA issued a LHA level of 70 ppt for PFASs in May 2016. In April 2016, 19 of the 23 permitted wells were sampled while the remaining four were either offline or could not be sampled. In June 2016, after receipt of the initial results, two of the wells, including the "North Well" on the McChord Field and "Well 17" on Lewis Main were shut down and isolated from the JBLM drinking water system due to exceedances of the LHA (**Table 3-2, Figure 3-1**). In November of 2016, a second PFASs sampling event was conducted with the intent of sampling all 23 permitted water supply wells and seven (7) locations within the distribution system. While two (2) wells, Replacement well 2 and Sage well 2, could not be sampled because they were down for repairs or inoperable due to mechanical malfunction, the remaining 21 wells and 7 locations within the distribution system were sampled. The November 2016 sampling results reported PFASs exceedances of the LHA level at the two wells previously shut down, McChord Field North Well and Lewis Main Well 17, as well as the McChord Field South Well. The April 2016 exceedances at Replacement Well 1 and Well 22 were not confirmed during the November 2016 event (**Figure 3-1, Table 3-2**). A total of three of the installation's drinking water wells have been shut down and isolated from the system due to PFASs concentrations above the LHA level. The JBLM Water Program is currently conducting additional analytical monitoring for PFASs compounds in the JBLM Drinking Water Production Systems (there are five separate systems) and a recurring monitoring program for the JBLM drinking water supply wells is being implemented. The JBLM on-post water supply wells and system configuration are discussed in **Section 4.5.2**.

The JBLM Water Program Office is working with the Washington State Department of Health (WDOH) to address the PFASs. Temporary and permanent treatment options are being evaluated, including temporary wellhead treatment and more permanent solutions for incorporation into future water treatment systems. A public notice that includes testing results and an explanation of the treatment system will be issued prior to placing any of the three wells back online. A public notice and news release were issued on March 1, 2017 and March 2, 2017 to all consumers at JBLM and drinking water utilities in surrounding communities, notifying of the PFASs monitoring results and subsequent actions. Copies of the public notice and news release are included in **Appendix 3**[2].

[2] The public notices include an error in the total wells sampled. The FYR text, Table 3-2, and Figure 3-1 represent the JBLM water well data collected during April and November 2016. A note of correction has been added to the public notices in Appendix 3.

3.6.1.2 Communication with Water Supply Districts near JBLM

On March 2, 2017, the JBLM environmental office submitted a copy of the public notice and news release to all drinking water utilities in the surrounding communities. **Figure 3-2** presents the location of water utility districts surrounding JBLM. On June 2, 2017, an initial meeting was held between JBLM and staff from the Lakewood Water District. Information collected to date concerning PFASs contamination of drinking water was presented by JBLM staff.

At the request of the WDOH, a meeting was held at the Lakewood Water District office on June 30, 2017. Although no formal meeting minutes have been prepared, representatives from most of the local water districts were in attendance, along with WDOH and the Tacoma-Pierce County Health Department. The WDOH presented the latest available information concerning PFASs contamination in groundwater. The JBLM staff presented a map summarizing the latest PFASs drinking water well sampling data collected at JBLM. A copy of the map was provided to the Lakewood Water District and the Spanaway Water Company. During the meeting, JBLM discussed the two major Army initiatives underway: a Corps of Engineers rapid response contract effort to provide granular activated carbon treatment for contaminated water wells, and a separate groundwater investigation focusing on PFASs. JBLM will continue to provide WDOH and surrounding water supply districts with updated PFASs monitoring results.

3.6.1.3 Evaluating PFASs Contamination at JBLM

PFASs sampling to date has been conducted on a voluntary basis by the Army as there are currently no Federal or State directives driving this work (such as a Federal Facility Agreement or modification specific to PFASs).

In spring 2017, JBLM issued an internal request to Army headquarters to initiate a Site Investigation (SI) for PFASs groundwater contamination. The purpose of the SI will be to investigate and assess PFASs contamination at JBLM and surrounding communities, consistent with USEPA guidance for Performing Site Inspections (https://semspub.epa.gov/work/11/174029.pdf) and 2016 Department of Army guidance to assess the following as possible source areas for PFASs: known fire training areas, Aqueous Film Forming Foam (AFFF) storage locations, hangars/buildings with AFFF suppression systems, fire equipment maintenance areas, and areas where emergency response operations required AFFF use. Under the SI process, the former fire training areas located at both Lewis-Main and the McChord field will be investigated as potential sources of PFASs.

The JBLM Installation Restoration Program (IRP) under the Defense Environmental Restoration Program (DERP) is responsible for managing cleanup of contaminated sites at JBLM, including CERCLA sites. The existing program is based upon a Federal Facility Agreement, a State of Washington Consent Decree and an Agreed Order. Following receipt of funding, the SI phase of work is expected to be complete within three years.

The presence of PFASs at or near the CERCLA sites included within this FYR has not been evaluated. In particular, the Logistics Center and the ALGT represent the two sites with pump and treat systems which have potential to intercept groundwater containing PFASs, whether a result of historical contamination associated with the CERCLA sites or broader PFASs contamination at JBLM which will be further defined through the SI process. These two sites have potential to affect protectiveness if

PFASs are present above the LHA level, and treatment systems are not configured to adequately treat PFASs prior to discharging. At the Logistics Center, the treated discharge from the three pump and treat systems are routed to various locations for beneficial reuse and then to infiltration galleries (LF-2 and I-5) and an infiltration pond (SLA) as depicted on **Figures 5-2**, **5-3**, and **5-4**. Similarly, ALGT discharges treated groundwater to infiltration trenches near the groundwater treatment building (**Figure 7-3a)**. Both the I-5 infiltration galleries and the ALGT infiltration trenches are near the JBLM boundary. Reinjection of groundwater with PFASs above the LHA level could result in redistribution of PFASs. Therefore, due to the unknown presence of PFASs at the influent and effluent of the pump and treat systems and corresponding discharge locations, a protectiveness determination cannot be made until further information is obtained. Therefore, protectiveness has been deferred for both the Logistics Center and ALGT detailed in Sections 5.0 and 7.0, respectively.

As part of the SI process, JBLM has proposed collection of water samples and analysis for PFASs at the following locations:

- Logistics Center
    - Landfill 2 – two source area monitoring wells
    - Influent and effluent water from the three P&T systems – LF-2, I-5, and SLA

- ALGT
    - 3 wells within the footprint of the groundwater TCE plume including one near the infiltration trenches
    - Influent and effluent water from the P&T system, if operation is resumed

Sampling will be completed within one year or prior to September 2019. Based on these results, protectiveness of the Logistics Center and ALGT remedies will be reevaluated and a protectiveness determination submitted to the USEPA as an addendum to the 2017 FYR by September 2020.

The presence of PFASs at Landfill 1 and 4 will also be assessed through collection of groundwater samples from three monitoring wells at each site.

JBLM estimates that the installation-wide investigation of PFASs, including agreed decision documentation may require four to seven years; however, the results of the SI will help refine the estimated investigation timeframe.

4.0 Installation-Wide Background and Land Use Controls

This section provides a brief overview of the site location and history, hydrogeologic setting, land and resource use, history of contamination, initial response, and existing site-wide LUCs. Site specific information can be found in subsequent sections.

4.1 Site Location and History

JBLM is located about three miles south of Tacoma, Washington along Interstate 5, which bisects the installation (**Figure 1-1**). In 2005, Fort Lewis and McChord Air Force Base (AFB) were designated as a joint base (i.e., JBLM) under the Base Realignment and Closure program. The former McChord AFB (4,639 acres) was adjacent to the northeast boundary of the former Fort Lewis (86,198 acres). JBLM became fully functional in October 2010. The installation occupies 90,837 acres in Pierce and Thurston Counties, Washington. The mission of JBLM is to provide logistical support and maneuver areas, range and facilities for I Corps and supporting units. It also provides worldwide military airlift capability. JBLM supports an on-base population and in neighboring communities of more than 100,000 people including military personnel, families, civilian and contract employees, and retirees and their families. JBLM has an Army joint base commander and an Air Force deputy commander. Base services are managed and provided by the Army. JBLM is divided into three distinct areas as shown on **Figure 1-1**: Lewis-Main (Former Fort Lewis), McChord Field (Former McChord Air Force Base), and Lewis-North (Former North Fort Lewis, north of Interstate 5)

JBLM is surrounded by the communities of Lakewood to the north (population 58,000), Olympia, Lacey, and Tumwater (population 86,000) to the south, DuPont to the west (population 7,500), and unincorporated Spanaway/Parkland to the east.

4.2 Hydrogeologic Setting

The following description is based on the text in the *Numerical Flow and Transport Model for the Fort Lewis Logistics Center – PNNL* (July 2006). This description of the hydrogeologic units also applies to McChord Field with the exception of the “window”, which is not known to exist at McChord Field.

The major hydrogeologic units are as follows:

- The upper unit is termed the Vashon Unconfined Aquifer (Vashon Aquifer). The thickness of the Vashon Aquifer is approximately 100 ft. It is composed of interlayered outwash and glacial till layers that generally overlie an older glacial outwash termed the Pre-Olympia drift. Scattered non-glacial deposits lie between the Vashon and the Pre-Olympia Drift. In the vicinity of the Logistics Center plume, the Vashon is divided into an Upper Vashon and Lower Vashon aquifers that are separated by discontinuous lower permeability till (**Figure 4-4**). Generally, there is communication between the Upper and Lower Vashon Aquifers, their potentiometric surfaces are generally the same. The distinction between the Upper Vashon Aquifer and the Lower Vashon Aquifer is poorly understood in the area of the Logistics Center. Within the Area D/ALGT area, there is a lower permeability muddy gravel zone (higher clay content) located approximately 50 to 70 feet below ground surface.

- A generally continuous non-glacial unit having aquitard properties (termed the Qpon Aquitard) underlies the Vashon Aquifer. The thickness of the aquitard varies but it is generally from about 10 to 20 ft thick where the aquitard is present. However, the Qpon Aquitard is locally breached, and one of these breaches is located just near the centerline of the existing TCE plume, between the source area at Landfill 2 and the I-5 extraction system. This breach is termed the "Qpon window" or "window" and it provides a conductive pathway for contaminated groundwater to flow between the Vashon Aquifer and the underlying SLA (**Figure 4-4**). The hydraulic gradient at this window is downward. Locations of other breaches have been inferred based on borehole logs but are less well defined than this window within the TCE plume.

- Beneath the aquitard is the confined SLA. The SLA is composed of glacial drift with minor silt layers and local areas of till, and it is bounded at the bottom by another non-glacial deposit with aquitard properties. The thickness of the SLA varies between about 50 and 100 ft thick.

- Groundwater flow patterns are complex. The extent of the "window" in the Qpon aquitard is not known.

- In addition, the 2006 modeling report (Truex, 2006) discusses a "lacustrine sediment feature" that is described as a large geologic feature oriented generally as a north-south trench filled with glaciolacustrine sediment. This lacustrine sediment feature cuts through the Qpon aquitard and extends more than 50 ft down into the SLA, and serves as a barrier to flow. The "window" in the Qpon aquitard is located just down-gradient of this lacustrine sediment feature (based on flow direction in the Vashon aquifer). The modeling report suggests that the lacustrine feature has a significant impact on hydraulic gradients and flow patterns. The modeling report suggests that the lacustrine sediment feature substantially restricts horizontal flow volumes in the SLA upgradient of the "window", such that impacted groundwater that flows downward to the SLA through the "window" is not substantially diluted. Another feature that adds to the complex flow pattern is American Lake. Groundwater in the Vashon Aquifer flows towards American Lake, but water in the deeper SLA (which has lower hydraulic head than the lake) is diverted to the south around the lake. These features cause the orientation of the plume in the deeper SLA (generally to the southwest) to differ from the orientation of the plume in the Vashon Aquifer (generally to the northwest).

- The 2006 modeling report makes the statement that "*The lacustrine sediment feature and associated SLA till and the influence of American Lake are the most important hydrologic features related to the groundwater flow field in the area of the TCE plume. These features combine to create an area of the SLA where the groundwater flow has a relatively low gradient, and the direction of flow turns 90º toward the south compared to the regional flow direction in the SLA…where the hydraulic barriers created by the lacustrine sediment feature and associated till and American Lake are shown in relation to the hydraulic head contours. The window between the Vashon Aquifer and SLA is located just down gradient (in the Vashon Aquifer) of the lacustrine sediment feature and is a significant source of groundwater to this area of the SLA…*"

For the Vashon Aquifer, the ROD (USEPA, 1990b) states the following with respect to groundwater flow velocity:

> *"Groundwater beneath the Logistics Center is recharged by groundwater inflow from the southeast and from infiltration of precipitation through the permeable soils. The water table gradient (slope) is to the north - northwest across the Logistics Center and is approximately10 feet per mile. Groundwater velocities range from 0.03 to 26 feet per day, with a median velocity of 1.5 feet per day. Aquifer transmissivity ranges from 14,000 to 20,000 gallons per day per foot."*

The distance from Landfill 2 to the I-5 system is approximately 8,000 feet. Assuming a groundwater flow velocity of 1.5 ft/day as stated in the ROD, a particle of groundwater would flow approximately 550 ft per year and would require approximately 15 years to reach the I-5 system from the source area at Landfill 2. This is a simplification since hydraulic properties are not uniform across this entire distance, but this simple calculation provides a reasonable first estimate regarding transport time from the source area.

4.3 History of Contamination

4.3.1 Regulatory Administration

Regulatory administration for JBLM non-CERLCA installation restoration program (IRP) sites is conducted by the Washington State Department of Ecology (Ecology). At McChord Field, the program is administered through a Consent Decree that was issued in 1992. At Lewis, the non-CERLCA sites are regulated under two programs:

- The RCRA program administered by the Hazardous Waste and Toxics Reduction section of Ecology through an Agreed Order issued in 2001
- Voluntary cleanup through the MTCA Toxics Cleanup Program

4.3.2 Lewis Main

TCE was used extensively as a solvent at the Logistics Center from 1942 to 1975 at which time TCE was replaced by trichloroethane. Used solvent sludge was treated and disposed at various locations within the Logistics Center. In 1985, the Army identified traces of TCE in several monitoring wells installed in the unconfined aquifer beneath the Logistics Center which led to additional investigations that identified the full extent of the contaminated groundwater and traced the primary source to Landfill 2. Waste disposal in landfills, spills, and illicit dumping are responsible for contamination at remaining sites. A number of these sites were identified during a 1986 Resource Conservation and Recovery Act (RCRA) facilities assessment.

4.3.3 McChord Field

McChord Field started as McChord Army Air Field in 1938 and became McChord Air Force Base when the Air Force became a separate military service in 1947. The base served as a component in the strategic air defense command structure as an airlift base from World War II to the present day. In August 1982, a Phase I Records Search (CH2MHill, 1982) identified 62 sites at the installation, including fire training areas, spill areas, landfills, and waste pits. Three additional sites were identified in 1984, 1989 and 1991.

4.4 Initial Response

In 1990, 16 Lewis-Main sites were incorporated into the Fort Lewis Federal Facility Agreement (FFA) between the Army, USEPA and Ecology (EPA, 1990a). The Army is the lead agency for addressing the environmental response at these sites. The FFA establishes the framework for procedures, schedules and standards related to characterization and cleanup efforts.

In 1989, a FFA (EPA, 1989) was signed by McChord AFB, EPA, and Ecology to address two sites, the ALGT, an area of private property adjacent to McChord AFB, and the former aircraft Washrack/Treatment Area (WTA). Both sites were placed on the NPL.

4.5 JBLM Land Use Controls and Groundwater Use Restrictions and Monitoring

4.5.1 Land Use Controls

In this report, LUCs are defined as engineering, institutional, and other governmental or administrative controls that restrict use or limit access of property, including subsurface portions such as groundwater. Thus, LUCs are a broader range of controls that include institutional controls as a subset. JBLM has LUCs in place to ensure protection of human health and the environment at sites where UU/UE could result in unacceptable risks to human health and the environment. An overview of the LUCs for the sites in this FYR are included on **Figures 4-1** and **4-2**.

This FYR evaluated whether the LUC objectives associated with each remedy are meeting RAOs, the mechanisms in place to ensure LUCs are maintained continue to remain effective, and monitoring and enforcement are consistent with the Draft 2016 JBLM LUC Plan. In 2007 and 2011, LUC Plans were finalized for Fort Lewis and McChord, respectively. A draft joint-base LUC Plan was generated in 2014, updated in December 2016, and is under regulatory review. This FYR referenced the draft JBLM LUC Plans to evaluate effectiveness of LUCs.

The Draft 2016 JBLM LUC Plan outlines the following mechanisms for ensuring site-specific LUC objectives are maintained:

- **LUC Data Layer in Geographic Information System (GIS):** The LUC data layer in GIS contains the specific LUC locations at JBLM and the specific LUC objectives for each location.

- **LUC Overlay for Real Property Master Plan:** The JBLM Real Property Master Plan delineates the major uses of real property and represents the formal decision process for the use of all land at JBLM. Army Regulation (AR) 210-20, which requires maintenance of the Real Property Master Plan and LUC overlay

- **LUC Overlay for Environmental Review Procedures:** These environmental review procedures are in place to ensure that all environmental considerations, including LUCs, are accounted for and adequately addressed during the preliminary project planning process.

- **LUC Overlay for Digging Permit Approval:** Before any digging or excavation activities are undertaken at JBLM, a JBLM Digging Permit must be obtained. The JBLM Environmental Restoration Program maintains the LUC overlay and provides to the staff responsible for issuing the dig permits.

- **LUC Inclusion in Operational Range Regulations:** while this LUC mechanism does not apply to sites covered under this FYR, it ensures LUCs are considered in operational range regulations and activities.

- **LUC Incorporation in Water System Plans:** The Draft 2016 JBLM LUC Plan states that the LUC objectives will be incorporated into the next update of the JBLM Cantonment Area Water System Plan (WSP) to ensure that a new drinking water well is not installed within 1000 feet of the landfill boundaries without obtaining a variance from Ecology. See **Section 4.5.2.**

- **Installation Access:** JBLM is a controlled military installation that limits access to authorized personnel.

LUCs are monitored through annual inspection of the sites and interviews with the staff responsible for maintaining the LUC overlays. Annual checklists were reviewed from 2011 through 2015 as part of this FYR and findings are discussed within individual site sections. An example checklist is included in **Appendix 3**.

4.5.2 Groundwater Use Restriction

Many of the CERCLA sites include an LUC objective to restrict installation of new drinking water wells without an EPA approved monitoring plan. The Final 2017 JBLM LUC Plan states that incorporating the LUC objectives into the next update of the JBLM Cantonment Area Water System Plan (WSP) will be a LUC mechanism to ensure that a new drinking water well is not installed within 1,000 feet of the landfill boundaries without obtaining a variance from Ecology.

These LUC boundaries are within the service area boundary of the JBLM Cantonment Area WSP. A WSP is the primary planning tool for all public water systems and is typically used to plan future construction, including installation of new drinking water wells. WSPs are required to be updated every six years in accordance with Washington Department of Health regulations in Washington Administrative Code 246-290-100. The Washington Department of Health will not approve installation of a new drinking water well without adequate documentation of the need for a new well in the WSP as well as adequate incorporation of the proposed well in the Wellhead Protection Program portion of the WSP. The JBLM Water Systems Manager within the JBLM Public Works Operation and Maintenance Division is responsible for maintaining the WSP as well as a variety of other planning, design, and operation tasks related to the JBLM Cantonment Area Water System. The JBLM ERP provides the JBLM Water Systems Manager with a copy of this LUC Plan and access to the GIS LUC data layer to incorporate the drinking water well related objectives in the WSP update. Annual LUC inspections and certifications include interviewing the Water Systems Manager to ensure they have access to environmental drinking water restrictions, LUCs and any updates continue to be included in WSPs, and to identify plans for new drinking water wells in the JBLM Cantonment Area Water System.

4.5.3 On-Post Water Supply Wells

Given the proximity of on-post water supply wells to sites included within this FYR, the following information was compiled about the wells and water distribution system to evaluate the potential for drinking water receptors.

JBLM Public Works owns five water systems permitted through the Washington State Department of Health (WDOH) to supply drinking water. A summary of wells associated with each system is in **Table 4-1**, below, and the well locations are shown on **Figure 3-1**.

1. **JBLM Lewis** has one primary drinking water source (Sequalitchew Spring) and seven secondary drinking water wells at various locations. The secondary source wells are available for use during peak demand periods or for emergency operation.

2. **JBLM Golf Course (GC)** includes one well that serves the west golf course.

3. **JBLM (ASP)** includes two wells

4. **JBLM (Range 17)** includes one well which serves a few buildings in the range area, not in the cantonment area

5. **JBLM McChord Field** includes 11 wells divided into three sub-systems (housing wells, sage wells, and central base wells) which extract from the Vashon and Salmon Spring Aquifers

Table 4-1. Summary of On-Post Drinking Water Supply Systems and Wells

JBLM Lewis	JBLM McChord Field
Sequaltichew Spring	Housing Well I (Housing)
Well #6	Housing Well II (Housing)
Well #12A AFK704	Housing Well III (Housing)
Well #17	Sage Well I (Sage)
Well #13	Sage Well II (Sage)
Well #12B	North Well (Central Base)
Well #20	South Well (Central Base)
MAMC Well #4	East Well (Central Base)
JBLM (GC)	Replacement Well I (Central Base)
Well #22	Replacement Well II (Central Base)

JBLM (ASP)	MARS Hill Well (Central Base)
Well #10	
Well #23	
JBLM (Range 17)	
Well #24	
Well #14	

Each one of these systems has a water quality monitoring schedule and an inventory report which summarizes type of water use, treatment, construction depth, and capacity. These can both be found at the following website: http://www.doh.wa.gov/DataandStatisticalReports/EnvironmentalHealth/DrinkingWaterSystemData.

According to Mr. Fogg at JBLM Public Works, Facilities the three sub-systems at McChord (central base, housing, and sage) are connected together by piping for emergency supply purposes. There is a single pipe connecting Housing and Sage wells and two pipes connecting Sage and Central Base wells. These last two are always connected. The valve to the three housing wells from the sage wells is typically closed as the housing wells are fluoridated. The sage and central base wells are not fluoridated. The JBLM Lewis wells and spring are fluoridated. The McChord wells are on the same pressure gradient and same grade so they can work together, while the three housing wells are connected to the housing grid/reservoirs.

Replacement Well #2 at McChord is currently sanded in and will be decommissioned in the future. A replacement well is being installed north of Area D/ALGT along the northern installation boundary. The Mars Hill well sits near a radio tower and is not connected to the water grid system. It will be taken out of service in 2017 and decommissioned once funding is authorized.

The monitoring schedules on the WDOH website indicate the wells are sampled for VOCs on variable schedules including 3 year standard, 6 year waiver, or 1 year sampling events. According to the McChord and Lewis 2015 Drinking Water Consumer Confidence Reports[3], the well systems are compliant. According to the McChord Consumer Confidence Report, TCE and *cis*-DCE were detected but below drinking water standards in 2015. VOCs were not detected in the Lewis wells.

JBLM Public Works has a Comprehensive Water Plan that is in the process of being updated (e.g., several wells are listed in the plan that are no longer in service). The inventories and records maintained by WDOH, however, are up to date.

[3] http://www.lewis-mcchord.army.mil/publicworks/docs/envir/LewisH2O.pdf; http://www.lewis-mcchord.army.mil/publicworks/docs/envir/McChordH2O.pdf

In summary, the existing on-post water supply wells are on a monitoring schedule which includes analysis for VOCs and are in compliance with drinking water standards for VOCs. As stated in **Section 3.6.1**, JBLM Water Department is in the process of implementing a recurring monitoring program for PFASs and have taken wells above the LHA level offline until a treatment program can be implemented.

4.5.4 Land Use

This FYR reviewed the current and anticipated future land use for each of the sites and compared to land use restrictions outlined in the Draft 2016 JBLM LUC Plan (**Table 4-2**). Current and future land use was gathered through document review, inspections during the site visit, and a review of the Real Property Master Plan. **Figure 4-3** presents the land use plan included in the Master Plan. Based on this review, the current and future land use for each of the sites in this FYR was consistent with LUC objectives.

Table 4-2. Land Use Summary

OU	FYR Site	Current and Anticipated Future Land Use	Land Use Restriction (if present)	LUC Plan Meets Land Use Restriction?
OU1	Logistics Center	Current land use at Landfill 2 is as a restricted industrial cleanup area within Training Area 7 of the Lewis-Main operational range area. Current and anticipated land use designated in the Fort Lewis Master Plan for the areas over the downgradient Vashon Aquifer and SLA TCE plumes is mixed. The majority is industrial/maintenance with a smaller percentages of land designated for family housing (residential), medical (equivalent to commercial), and open space. Current and anticipated land use in the off-post Tillicum community is a mix of residential, commercial, and open space.	Landfill 2: Prevent residential land use Upper Vashon Aquifer TCE 100 ug/L isoconcentration contour: Prevent residential land use	Landfill 2: yes Upper Vashon Aquifer TCE 100 ug/L isoconcentration contour: Yes
	Illicit PCB Dump	The current and anticipated future land use at the site is restricted within the JBLM operational range area.	Site boundary: prevent residential land use.	Yes.
	Landfill 1	LF 1 is located in an area designated for maintenance in the Lewis-Main Master Plan. The main portion of the landfill is currently not being used and has vegetation growing on the cap. Paved parking lots are constructed over former open pit dumping areas. Future land use for the site may include development of recreational ball fields. The current and anticipated future land use designated for LF 1 in	Site boundary: prevent residential land use.	Yes.

OU	FYR Site	Current and Anticipated Future Land Use	Land Use Restriction (if present)	LUC Plan Meets Land Use Restriction?
		the Lewis-Main Master Plan is industrial/maintenance.		
	Battery Acid Pit	The current and anticipated future land use designated for the site in the Lewis-Main Master Plan is industrial/maintenance.	Site boundary: prevent residential land use.[1]	Yes.
	DRMO	The site is currently used as an active industrial laydown yard for surplus material to be recycled. The anticipated future land use designated for the site in the Lewis-Main Master Plan is industrial/maintenance.	Site boundary: prevent residential land use.	Yes.
	IWTP	The site is currently used as an active industrial laydown yard for surplus material to be recycled. The anticipated future land use designated for the site in the Lewis-Main Master Plan is industrial/maintenance.	Site boundary: prevent residential land use.	Yes
	Pesticide Rinse Area	The current and anticipated future land use designated for the Pesticide Rinse Area in the Lewis-Main Master Plan is administration, which is equivalent to commercial (residential use is not allowed).	Site boundary: prevent residential land use.	Yes.
OU2	Landfill 4	Current and anticipated future land use for LF 4 is restricted training within Training Area 2 of the Lewis-Main operational range area.	<u>Landfill boundary:</u> prevent residential land use.	Yes.
OU2	SRCPP	The current and anticipated future land use designated for the SRCPP in the Lewis-Main Master Plan is administration, which is equivalent to commercial.	None.	Not applicable.
OU3	ALGT	ALGT is an off-base residential tract abutting the southwestern boundary of McChord Field that lies between JBLM property and I-5. This tract consists of 1,183 housing units (mostly apartments) with approximately 3,400 residents. A base golf course and driving range now overlie former landfills that were part of the Area D disposal area.	Landfills 5, 6, 7 and OT-39: prevent residential land use	Yes.

[1]Prevention of residential land use appears on annual inspection checklist but does not appear in Draft 2016 JBLM LUC Plan, Table 1.

5.0 Operable Unit 1 - Logistics Center

Operable Unit 1 (OU1) is comprised of the following sites:

- Logistics Center (NPL) – FTLE-33
- Illicit PCB Dump Site (non-NPL) – FTLE-46
- Landfill 1 (non-NPL) – FTLE-54
- Battery Acid Pit (non-NPL) – FTLE 16
- DRMO Yard (non-NPL) – FTLE-31
- IWTP (non-NPL) – FTLE-51
- Pesticide Rinse Area (non-NPL) – FTLE-28

Because the sites above have different response actions, this section is structured to discuss the history, response action, data review, and technical assessment for each site (Section 5.1 through 5.5). A combined set of issues, recommendations, and one protectiveness statement specific to OU1 are included in Sections 5.6, 5.7, and 5.8, respectively.

5.1 Logistics Center

5.1.1 Background: Logistics Center

The Logistics Center is the largest and most impacted site at JBLM with the main source area being Landfill 2 (LF 2) located at the southeastern edge of the Logistics Center. See **Figure 4-1** for an overview of JBLM site locations included in this FYR. LF-2 (formerly known as the East Gate Disposal Yard [EGDY]) was a 23-acre landfill used between the 1940s and late 1960s/early 1970s (**Figure 5-1**). Trichloroethylene (TCE) was used historically at the Logistics Center in large quantities as a degreasing agent until the mid-1970s when its use was replaced by trichloroethane (TCA). Waste TCE, which was the principal degreaser used for maintenance at the Logistics Center, was disposed along with waste petroleum products.

In 1985, the Army identified traces of TCE in several monitoring wells installed in the unconfined aquifer beneath the Logistics Center. A limited site investigation (SI) (USACE, 1986) was performed in 1986 at which time it was discovered that TCE contaminated groundwater originating from the Logistics Center was a potential threat to the Lakewood Water District well located in nearby Tillicum. During 1986 and 1987, the USEPA performed a groundwater investigation in and around Tillicum and found that groundwater contamination originated from the Logistics Center. The Army agreed to study the groundwater plume off the installation as part of the Logistics Center RI (Envirosphere et al, 1988). In 1988, the RI was modified to include study of the horizontal extent of the off-post groundwater plume.

The results of past investigations have identified a plume of TCE in the Vashon Aquifer and underlying SLA. Both plumes originate from LF-2. The “source” of the TCE plume in the SLA is contamination originating from LF-2 that passes through a hydrogeologic preferential pathway (commonly called the “window”) between the Vashon Aquifer and SLA. This "window" enables TCE to enter the SLA from the Vashon Aquifer at a location about halfway along the Vashon Aquifer plume.

Current land use for LF-2 is as a restricted industrial cleanup area within Training Area 7 of the Lewis-Main operational range area. Current and anticipated land use designated in the Fort Lewis Master Plan for the areas over the downgradient Vashon Aquifer and SLA TCE plumes is mixed. The majority is industrial/maintenance with smaller percentages of land designated for family housing (residential), medical (equivalent to commercial), and open space. Current and anticipated land use in the off-post Tillicum community is a mix of residential, commercial, and open space.

5.1.1.1 Site Chronology

Table 5.1-1: Chronology of Site Events at Logistics Center

Event	Date
Trichloroethylene (TCE) discovered in shallow groundwater beneath the Logistics Center.	1985
RCRA Facility Assessment (RFA) completed	1986
Remedial Investigation	1988
Logistics Center added to NPL	1989
Feasibility Study	1990
FFA signed; Logistics Center ROD signed	1990
Construction of two Logistics Center P&T systems in Vashon Aquifer begins	1992
LF 4/SRCPP ROD signed and sites added as operable units to Logistics Center	1993
Logistics Center Vashon Aquifer P&T systems begin operation	1995
First FYR for Logistics Center	1997
Logistics Center Explanation of Significant Difference (ESD) signed	1998
LF-2 Pump and Treat Completion Report	1998
DD for Logistics Center source area drum removal action signed	2000
Drum removal action at Logistics Center source area conducted	2000-2001
RI Phase II Logistics Center	2002
DD for Logistics Center source area in-situ thermal treatment signed	2002
Second FYR completed	2002
Logistics Center source area Vashon Aquifer P&T system re-configured	2003-2006
In-situ thermal treatment at Logistics Center source area conducted	2003-2007
DDs for Battery Acid Pit, DRMO Yard, Illicit PCB Dump Site, LF 1, and LUCs at Logistics Center source area (LF-2 [EGDY] soil) signed	2006
ESD for Logistics Center SLA signed	2007
Third FYR completed	2007
Startup of Sea Level Aquifer (SLA) P&T system	2009
First Installation Wide Five-Year Review (Fourth FYR – Logistics Center)	2012
I-5 Pump and Treat Performance Assessment	2013
Preliminary Closeout Report (documents Operational and Functional)	2015
2011-2015 Annual Monitoring Report	2012-2016
2011-2015 Logistics Center Remedial Action Monitoring Reports	2012-2016
Addendum to the First Five-Year Review Report for JBLM	2014

Logistics Center Indoor Air VI Study Report	2016

5.1.1.2 Initial Response

In the late-1980s, as a result of the Vashon Aquifer contamination, impacted domestic water wells in the community of Tillicum were shut down.

5.1.1.3 Basis for Taking Action

The COCs identified in groundwater at the Logistics Center are:

- Trichloroethylene (TCE)
- cis-1,2-Dichloroethylene (*cis*-DCE)
- Tetrachloroethylene (PCE)
- 1,1,1-Trichloroethane (TCA)
- Vinyl Chloride (VC)

Analysis of the soil, groundwater, surface water, and sediments indicated that groundwater contamination is the principal threat at the Logistics Center. The potentially exposed populations include the residents of Tillicum and the ALGT that may have contaminated private wells. Potential exposure may occur if new private wells were to be installed into the unconfined aquifer. The Baseline Risk Assessment considered human health and ecological risks. The pathways considered were on-post workers, on-post residents and off-site residents, and the ecological receptors included aquatic organisms and local small mammals. Exposure routes for groundwater included ingestion, dermal contact and vapor inhalation. Exposure routes for surface water considered ingestion, dermal contact, vapor inhalation and fish consumption. For soil, ingestion, dermal contact, vapor inhalation and particulate inhalation.

A Risk Assessment Addendum (URS 2001b) covering human and ecological health not previously addressed in the baseline risk assessment (completed in 1990) was published in 2001 in draft form. The addendum human health evaluation focused on soils within LF-2, vapor intrusion (VI) into buildings from chemicals within the Vashon aquifer plume, and use of the SLA as a drinking water source. Risks and hazards due to indoor inhalation of vapors from the Vashon aquifer were within USEPA's acceptable risk ranges (between 10^{-4} to 10^{-6} and <1, respectively) for both workers and residents. Risks and hazards from domestic use of SLA groundwater were above the target health goals. Risks and hazards for child trespassers and construction workers at LF-2 were above the target health goals. The ecological health evaluation was a limited, focused screening level risk assessment and was performed to quantify risks for aquatic biota and piscivorous wildlife due to volatile organic compounds (VOCs) in the surface waters of Murray Creek, which runs along the southwestern edge of the Logistics Center and is believed to be hydraulically connected to LF-2 and Logistics Center groundwater. No significant ecological risks for any of the target receptors were identified for any of the detected VOCs in Murray Creek.

5.1.2 Remedial Actions: Logistics Center

5.1.2.1 Remedy Selection

The selected remedy for the Logistics Center NPL Site is documented in a ROD dated September 1990 (EPA, 1990b). The remedy primarily addresses groundwater contamination and includes the following elements:

- Install groundwater extraction wells and treatment systems capable of capturing and treating the groundwater contaminant plume in the unconfined aquifer. Install extraction wells near areas of highest concentration of contamination. Discharge treated water upgradient of these extraction wells.
- Monitor the groundwater contaminant plume and the treatment system
- Implement Institutional Controls
- Investigate the lower aquifer(s) to determine presence and extent of contamination. If contamination is found, a groundwater extraction and treatment systems will be installed which is capable of capturing the contaminant plume with subsequent treatment of the extracted groundwater in the on-site treatment facility.
- Perform confirmation soil sampling to ensure all remaining sources of soil contamination are identified and characterized.

The goal of this remedial action is to restore groundwater to its beneficial use, which is, at this site, a drinking water source. The groundwater will be restored to levels consistent with state and Federal ARARs which will result in a cumulative excess cancer risk not to exceed 10^{-4}. Remediation levels will be attained throughout the contaminated plume.

The primary remedial action objective is to restore the unconfined aquifer to drinking water status. Cleanup goals were set at the maximum contaminant level (MCL) for all VOC contaminants. "The remediation goals specified for the unconfined aquifer will also apply to any contaminated lower aquifers" (EPA, 1990b)

An Explanation of Significant Differences (ESD) was completed in 1998 (EPA, 1998) to specify follow-on actions necessary to address the results of the investigations required in the 1990 ROD (EPA, 1990b).

- Soil sampling revealed that LF-2 (the EGDY) was the primary source of groundwater contamination. The ESD required enhancements to the remediation strategy to improve source removal considering innovative technologies.
- The ESD required further characterization of TCE in the unconfined aquifer by installing more monitoring wells and adding these wells to the groundwater monitoring program.
- Update and enhance the groundwater models to predict the fate and transport of TCE in both the upper and lower aquifers.
- Groundwater investigation revealed the presence of a TCE plume in the SLA and established the requirement to design and construct a remedial action.

Three Decision Documents (DD) established specific supplemental remediation activities. A July 2000 DD (Ft. Lewis, 2000) specified removal of buried drums. A DD dated August 2002 (Ft. Lewis, 2002) established in-situ thermal treatment for soil and groundwater. In April 2006 (Ft. Lewis, 2006a), a DD required installation of a perimeter fence around LF-2 and implementation of additional institutional controls. While the Decision Documents were not signed by the EPA, the EPA-authored Preliminary Close-out Report accepts the work completed and remedies in place at these sites.

Another ESD was completed February 2007 (EPA, 2007) to document the remedial action selected for the Logistics Center SLA which includes installation and operation of a groundwater pump-and-treat system in the SLA near Madigan Army Center with re-use of treated water at Madigan Army Medical Center.

5.1.2.2 Remedy Implementation

There are three groundwater P&T systems included in the Logistics Center remedial action. Their locations are shown on **Figure 5-1**. Remedy implementation began with the design and construction of the two Vashon Aquifer P&T Systems: the source area LF-2 P&T System and the downgradient Interstate 5 P&T System. Each Vashon Aquifer P&T System includes extraction wells, a packed tower aeration treatment unit, and infiltration system for discharge of treated water. Both LF-2 and Interstate 5 P&T systems began operating in 1995 and have been modified from the original system design. The current configurations of the LF-2 and Interstate 5 (I-5) systems are shown in **Figures 5-2 and 5-3**, respectively. In addition to the P&T systems, in-situ thermal treatment was accomplished at LF-2 in stages beginning in 2003 and ending in 2007.

The current LF-2 P&T System consists of eight extraction wells (PW-1 through PW-8). Treatment consists of an air stripping tower. Some of the treated effluent is used at the Army Reserve Center as a ground source heat supply, all treated water eventually discharges to infiltration galleries. In 2005 and 2006 the system was offline while the thermal treatment activity was underway (Tetra Tech GEO, 2011).

The Interstate 5 P&T System currently consists of a line of extraction wells (LX-2 though LX-15), a treatment unit, and four downgradient infiltration galleries that minimize further flow of dissolved-phase contaminants across the installation boundary towards the community of Tillicum. In addition, the original line-shaft turbine pumps used in the extraction wells have been replaced with variable-frequency capable submersible pumps to decrease maintenance requirements, improve operational flexibility, and enhance plume capture. The I-5 effluent line was modified since the last FYR to provide treated water as a ground source heat supply to new Tactical Equipment Maintenance Facilities; this is a throughput system, and the water then returns for discharge into the I-5 infiltration galleries.

Construction of the SLA P&T System began in September 2007, was completed in October 2009 and began continuous operation in March 2010. The SLA P&T System includes 11 additional monitoring wells (MWs), six extraction wells, a packed tower aeration treatment unit, and transmission of treated effluent to the Madigan Army Medical Center (MAMC) for re-use as hospital cooling water. The water is subsequently discharged to a lined pond that serves as a landscaping water feature, followed by an infiltration pond. The configuration of the system is shown on **Figure 5-4.**

5.1.2.3 Operation and Maintenance

5.1.2.3.1 Pump and Treat Systems

The LF-2 System and the I-5 System have been operated by a JBLM Public Works contractor since December 2004. The SLA P&T has been operated by the MAMC Facilities and Maintenance Department since it was commissioned in 2009; however, repairs of the SLA P&T are the responsibility of the JBLM Public Works contractor. The contractor employs staff at the installation full-time to accomplish program management, operation, maintenance, monitoring, and reporting for remedial actions at JBLM. Routine operation and maintenance is performed in accordance with a *Final Management Plan* (USACE, 1994a) and the O&M Plan (Fort Lewis, 2007b). O&M activities are reported annually. The O&M Plan requires weekly site visits for routine tasks. The system operator visits the treatment systems daily however, to closely monitor extraction well flow rates and make flow adjustments to avoid low water levels which trigger on/off cycling of the extraction wells.

All of the systems (I-5, SLA and LF-2) have operated nearly continuously since the last five year review. Full system outages have been relatively short, having to do with planned maintenance and repairs or short term outages resulting from power fluctuations. Pumps in several extraction wells were replaced at various times through the past five years, resulting in extended downtime at some individual wells. **Appendix 4** show extraction well flow rates over time.

Based on the recommendation from the last FYR, an assessment of the I-5 remedial system was conducted in 2013. The performance of the I-5 P&T system was evaluated in terms of capturing the Logistics Center TCE plume and the fate of the plume downgradient of the P&T system. Numerical simulations of plume fate and transport were also conducted to help interpret the existing data and to provide predictions of plume behavior in the future. The design flow rate is 1,600 gpm (recent annual averages were between 1,400 to 1530 gpm).

The LF-2 redesign flow rate is 800 gpm (between 2011 and 2015 annual averages were much lower and between 510 and 650 gpm). The SLA system has been continuously operated since March 2010. The design flow rate is 1,600 gpm (recent annual averages ranged from 1430 to 1720 gpm). Routine O&M is performed by the MAMC operations staff. JBLM inspects the system monthly and collects influent and effluent samples.

5.1.2.3.2 Groundwater and Performance Monitoring

Groundwater samples are collected from 51 monitoring wells screened in the Upper Vashon aquifer, 14 monitoring wells screened in the Lower Vashon Aquifer, and 46 monitoring wells screened in the SLA. Sampling is conducted based on a sampling schedule outlined in the Logistics Center Remedial Action Monitoring Program Compliance Monitoring Plan (Public Works, 2016) with sampling frequencies between quarterly and annually. The TCE plume maps generated for the Upper Vashon, Lower Vashon, and SLA are included in **Figures 5-5**, **5-6**, **and 5-7**, respectively.

Six monitoring wells were decommissioned in 2013 of which five monitoring wells, 88-OS-VD, LC-38, LC-38a, LC-125, and LCX-05, were part of the Logistics Center Remedial Action Monitoring (Log RAM) network. Monitoring wells 88-2-VD and 88-OS-VD were decommissioned to make way for a new gate and Access Control Point located on the west side of Lewis North and one replacement monitoring well, LC-104D, was completed approximately 150 feet northeast of 88-OS-VD (**Figure 5-8**). A new monitoring well (T-15) was installed to replace T-08 in September 2012 but was not properly developed until June 2014.

5.1.3 Progress Since Last Five-Year Review: Logistics Center

The protectiveness statement from the First Installation-Wide FYR was:

Subsite OU #	Protectiveness Determination[1]	Protectiveness Statement
Logistics Center	Short-term Protective	Determination of protectiveness is deferred, pending additional sampling to address the potential for vapor intrusion at industrial structures above the Logistics Center Plume and an evaluation of the capability of the I-5 groundwater extraction and treatment system to capture the Lower Vashon TCE groundwater plume. The vapor intrusion evaluation is expected to be complete in June 2013, and the evaluation of the Lower Vashon Aquifer plume capture should be complete in September 2013. Upon resolution of those issues, the Logistics Center remedy is expected to be protective of human health and the environment in the long-term. An addendum to determine the protectiveness will be prepared by September 30, 2014. Two of the three groundwater extraction and treatment systems are performing as expected. In-situ thermal treatment has significantly reduced contaminant mass flux from three NAPL source areas. Additional source treatment methods are being evaluated to further reduce source area mass. Due to the large size of the groundwater contamination plume, effects of mass reduction in the source area are not expected to be observed at the toe of the plume in the near term. LUCs are fully implemented and functioning as expected.

1 – While the 2012 FYR concluded the remedy was short-term protective, the actual protectiveness determination and submittal of FYR addendum evaluating protectiveness support a protectiveness deferred determination.

The recommendations from the previous FYR were:

Issue	Recommendations	Current Status	Current Implementation Status Description*	Completion Date (if applicable)
	Develop and implement an evaluation strategy for assessing the capture zone of the I-5 P&T extraction wells. In addition, determine if the Lower Vashon aquifer TCE plume is being captured by the I-5 P&T system.	Completed	A performance assessment of the I-5 P&T system was performed in 2013 (PNNL, 2013) and computer modeling shows the Lower Vashon aquifer is contained by the I-5 P&T system. The performance of the I-5 P&T system was evaluated in terms of capturing the Logistics Center TCE plume and the fate of the plume	9/30/2014

			downgradient of the P&T system. Numerical simulations of plume fate and transport were also conducted to help interpret the existing data and to provide predictions of plume behavior in the future.	
	Develop and implement a sampling plan to gather data to characterize the vapor intrusion risk.	Completed	In 2013, a vapor intrusion study was conducted and indicated a potential risk (GSI, 2013); therefore additional vapor intrusion sampling was conducted in 2016. Indoor air sampling was conducted in six buildings located above the plume where historically the highest concentrations of TCE have been detected. Only one building had TCE detected at 1.6 micrograms per cubic meter (µg/m^3); however this concentration is below the EPA Regional Screening Level for industrial air of 3 µg/m^3 (Versar, 2016). A formal addendum to the 2012 FYR to determine protectiveness based on these additional analyses described the above VI sampling.	NA

5.1.3.1 Evaluation of Different Source Treatment Methods

An Environmental Strategic Technology Certification Program (ESTCP) project began in October 2008 and was completed in 2010. The project was designed to demonstrate the benefits of combining low-energy electrical resistance heating (ERH) with in-situ bioremediation (ISB) and iron-based reduction using zero valent iron (ZVI), for the remediation of dense non aqueous phase liquid (NAPL) source zones in LF-2. The objectives of the demonstration included:

- Assess the extent to which contaminant degradation is enhanced during heating compared to ambient temperatures;

- The relative contribution of biotic and abiotic contaminant degradation mechanisms at different temperatures, and

- The cost-benefit of applying low-energy heating with in situ treatments.

The demonstration was conducted in three phases to improve the accuracy of evaluating the effects of ERH on ISB and ZVI reduction and comparison between the two applications. The final report published December 2012 focused on the application of these processes and cost effectiveness but did not have specific recommendations for future work at LF-2.

5.1.4 Document and Data Review: Logistics Center

5.1.4.1 Document Review

Documents associated with the Logistics Center groundwater investigations, remedy development, and operations were reviewed for this fifth FYR report. Key documents reviewed included:

EPA, 2015. Preliminary Close Out Report, Logistics Center. September.

ESTCP, 2012. Combining Low-Energy Electrical Resistance Heating with Biotic and Abiotic Reactions for Treatment of Chlorinated Solvent DNAPL Source Areas. December.

GSI Environmental Inc. (GSI), 2013. Use of Compound-Specific Stable Isotope Analysis to Distinguish between Vapor Intrusion and Indoor Sources of VOCs. Prepared for Department of Defense's Environmental Security Technology Certification Program (ESTCP) in association with the University of Oklahoma's School of Geology and Geophysics. November.

JBLM, 2016a. 2014 Operation and Maintenance Annual Report, Logistics Center Pump and Treat Systems. January.

JBLM, 2016b. Logistics Center Remedial Action Monitoring Program Compliance Monitoring Plan. July

JBLM, 2016c. Draft 2015 Operation and Maintenance Annual Report, Logistics Center Pump and Treat Systems. September.

JBLM, 2017. Draft Final Logistics Center Site Management Improvement Study Work Plan, Joint Base Lewis-McChord. April.

Kemron, 2010. Explanation of Significant Differences Logistics Center. October.

Pacific Northwest National Laboratory (PNNL), 2013. I-5 Pump-and-Treat System Performance Assessment. April.

PNNL, 2015. Performance Assessment for Pump-and-Treat Closure or Transition. September.

Tetra Tech Geo, 2011. Remedial System Evaluation. May

Versar, 2012. 2010 Operation and Maintenance Annual Report, Logistics Center Pump and Treat Systems. November.

Versar, 2012. 2011 Operation and Maintenance Annual Report, Logistics Center Pump and Treat Systems. November.

Versar, 2013. 2011 Annual Monitoring Report, Logistics Center Remedial Action Monitoring Program. January.

Versar, 2014. 2012 Operation and Maintenance Annual Report, Logistics Center Pump and Treat Systems. January.

Versar, 2014. 2012 Annual Monitoring Report, Logistics Center Remedial Action Monitoring Program. April.

Versar, 2014. 2013 Annual Monitoring Report, Logistics Center Remedial Action Monitoring Program. October.

Versar, 2016 Draft Logistics Center Indoor Air Vapor Intrusion Study Report. September.

5.1.4.2 Data Review and Evaluation

The following summary is based upon data and statistical analyses from the final 2013 and 2014 monitoring reports and the Internal Draft 2015 monitoring report. Sampling locations included and trend charts from the Draft Internal 2015 annual report are included in **Appendix 4**. TCE was the only COC detected above the RG. Cis-DCE, PCE and TCA were detected at concentrations below the RG. Vinyl chloride was not detected in the last two years of sampling.

Appendix 4 Figure 6-1 shows Upper Vashon Aquifer wells with a color coding based on the resulting TCE trend. In general, it appears that the TCE plume in the Upper Vashon aquifer is decreasing. However, one well showed a statistically significant increasing trend (85-PA-382) and four others displayed an increasing trend that was not statistically significant (CM-2, FL-04b, LC-135, and T-13b).

Although not part of the past several years of compliance monitoring, Well LC-202, located roughly between NAPL Areas 1 and 2 (**Figure 5-2**), showed the highest TCE concentration (130 μg/L) in 2011. LC-202 was sampled in March 2016 during the annual Logistic Center compliance monitoring event. The TCE concentration in March 2016 was 580 μg/L. This is the highest concentration from all of the wells sampled in 2015 or Spring 2016.

Appendix 4 Figure 6-2 presents the Lower Vashon Aquifer wells. Wells exceeding the MCL are decreasing in the upgradient portion of the plume. Two wells LC-116b and LC-226 have statistically significant upward trends. LC-116b is located between I-5 P&T system wells LX-7 and LX-8 and concentrations should be captured by the production wells. LC-226 is downgradient of the I-5 P&T system and has risen from concentrations below the MCL between the last FYR to concentrations currently exceeding the MCL. A recommendation for increasing the sampling frequency of this well is included in **Section 5.7**. Also in the Lower Vashon, TCE concentrations in production wells MAMC-1 (30 µg/L) and MAMC-6 (34 µg/L) were significantly higher than expected in 2015. The JBLM environmental restoration program reported that samples have been collected from these wells on a monthly basis and results were all below the MCL indicating the results from the single sampling event in 2015 were an anomaly. These results were not available for review for this FYR.

Appendix 4 Figure 6-3 presents the SLA wells. In the SLA, TCE concentrations are roughly the same order of magnitude found in the Vashon aquifer. Seven of the monitoring wells analyzed for the 2015 report showed an upward trend (LC-67D, LC-88D-1, LC-101D-1, LC-84D-2, LC-86D-2, LC-88D-2, and LC-94D-2), five of which are not statistically significant. The trend in LC-67D, located downgradient of the window between the Vashon and SLA but upgradient of the SLA P&T system, is not a statistically significant increasing TCE trend. Because the SLA P&T system has been in operation for just over five years, it was suggested in the Annual Report (Versar, 2016) that the increase in TCE seen in the other six wells downgradient of the system, is because this part of the plume has not been affected by the system.

As part of the 2010 LOGRAM Compliance Monitoring Plan, surface water at Murray Creek is sampled at three locations within the Logistics Center. Three surface water sampling points on Murray Creek (SW-MC-07 through SW-MC-09) are shown on **Figure 5-5**. SW-MC-07 through SW-MC-09 were added to the sampling program in 2010 and were sampled quarterly in 2010 through 2012 to establish data baselines. In 2015 the surface water sample points were sampled during the first quarter. In June 2010, surface water sampling at the MAMC HVAC cooling ponds located in front of MAMC was added to confirm that water discharged from the SLA P&T system and the MAMC production wells meet regulatory standards. All surface water samples had TCE concentrations below the ROD remediation goal of 5 µg/L.

5.1.4.2.1 P&T System Performance

Table 5.1-2 presents the groundwater extraction system total annual mass of TCE removed and removal efficiency from 2010 through 2015, and **Table 5.1-3** presents the cumulative flow for each of the systems. At LF-2 both PW-4 and PW-6 were out of service for the first 4 months of 2014, resulting in a decrease in overall well production and TCE removal for the LF-2 system in 2014.

Table 5.1-2 - Groundwater Extraction Systems Total Annual Mass of TCE Removed and Removal Efficiency

Logistics Center Groundwater Extraction Systems						
	LF-2		I-5		SLA	
	mass (lb)	Efficiency (lb/Mgal)	mass (lb)	Efficiency (lb/Mgal)	mass (lb)	Efficiency (lb/Mgal)
2010	141	0.39	144	0.22	73	0.13
2011	108	0.33	239	0.32	111	0.14
2012	119	0.32	221	0.31	100	0.13
2013	71	0.22	164	0.21	94	0.10
2014	61	0.24	193	0.26	96	0.13
2015	85	0.26	246	0.33	93	0.15

Table 5.1-3 - Groundwater Extraction Systems Cumulative Flow

Logistics Center Groundwater Extraction Systems Cumulative Flow (million gallons)			
	LF-2	**I-5**	**SLA**
2010	360	659	544
2011	325	739	799
2012	370	710	800
2013	323	791	905
2014	251	745	772
2015	325	742	615

5.1.4.2.2 Landfill 2 (EGDY) P&T System

The LF-2 system as currently configured (eight wells) commenced full scale operation in May 2007 (initial operation with six wells began in 1995). Annual volume pumped has generally stayed consistent in spite of extended periods of downtime for wells PW-1 and PW-7. The LF-2 redesign flow rate is 800 gpm (between 2011 and 2015 annual averages were between 510 and 650 gpm). The mass removal efficiency, expressed as pounds of TCE removed per million gallons extracted, has generally decreased over the last five years of operation. Data from individual extraction wells, shown in **Appendix 4**, identify some subtle decreases in TCE concentration over time. In addition, the LF-2 system influent TCE concentration shows more consistent values at lower levels beginning in July 2009 as shown in **Appendix 4**.

The wells with the highest concentrations, PW-1 and PW-3, had the lowest flow rates (along with PW-8) by a considerable amount. This can be observed in **Appendix 4**. The Remedial System Evaluation (RSE) Report completed in 2011 (USACE and Tetra Tech GEO 2011) stated, “The RSE team has some concern because extraction wells at the edge of the extraction network at the EGDY (LF-2) system (PW-1 and PW-3) have the highest TCE concentrations, and additional monitoring wells should be added in a manner to alleviate such concerns regarding capture.” In addition, operation staff indicated that the aquifer simply does not produce as effectively from these locations (i.e., lithology is limiting production and not well efficiency) and that additional investigation in the area was proposed in the Draft Final Site Management Improvement Study (SMIS) (JBLM 2017).

Since the last FYR, the air stripper has successfully shown removal of TCE from groundwater to below the discharge criterion of 5 µg/L, as shown in the effluent graphs in **Appendix 4**.

5.1.4.2.3 I-5 P&T System

Flow rates and TCE concentrations tend to be highest toward the center of the line of extraction wells. Mass removal efficiency has remained stable since the last FYR. Qualitative review of TCE concentration trends in individual extraction wells, as shown in **Appendix 4**, indicates some of the wells have no discernible downward trend. Given the distance between the LF-2 system and I-5 system (approximately 1.5 miles) and modeling report assumption that Landfill 2 source mass was cutoff in 2006, arrival of groundwater with significantly lower concentrations is not expected. As discussed in **Section 4.3**, the estimated travel time from LF-2 to I-5 system is approximately 15 years. Wells LC-132 and LC-19a, located between LF-2 and the I-5 systems do exhibit statistically significant downward TCE trends.

The air stripper at the I-5 system has continuously removed TCE from the groundwater to levels well below the discharge criterion, as shown in the effluent graphs in **Appendix 4**.

5.1.4.2.4 SLA P&T System

The system has been operating for six years, and total mass removal has slightly declined since 2011. Mass removal efficiency is lower than in the other pumping systems. Similar to the I-5 system, the line of wells shows higher concentrations and flow rates toward the center. Effluent concentrations in 2015 were below the TCE discharge criterion of 5 µg/L, as shown in the effluent graphs in **Appendix 4**.

Water levels have been collected from the monitoring network and all three aquifers indicate a depression in the water table surface near the pumping systems (LF-2, I-5 and SLA), indicating localized flow towards the extraction wells.

5.1.5 Technical Assessment: Logistics Center

5.1.5.1 Question A

Is the remedy functioning as intended by the decision documents?

The I-5 and SLA P&T systems are functioning as intended by the decision documents. The remedy for the source area LF-2 is functioning to reduce TCE concentrations, but is not optimized as the extraction wells installed within the area with highest TCE concentrations is underperforming. LF-2 system capture may not be complete and contaminants may be migrating beyond the LF-2 P&T capture zone.

5.1.5.1.1 Remedial Action Performance

Groundwater monitoring of the system is occurring at a reasonable frequency. The annual reports include trend analyses on numerous wells within the Logistic Center plume. As noted above, TCE concentrations have been declining at several monitoring wells. Trend data in LC-226, downgradient of the I-5 system, shows a statistically significant upward trend (**Appendix 4**) based on data collected between 2007 and 2016. Starting in 2014 the TCE concentration in this well exceeded the RG.

The groundwater extraction and treatment system and the supplemental removal actions and interim actions have been effective at reducing groundwater contamination and limiting migration of contaminants in groundwater. The effective implementation of land use controls prevents direct contact with the contaminated soils and sediments and exposure to contaminated groundwater.

The LF-2 data indicate that the monitoring well network is limited in its ability to assess TCE concentrations east of PW-1 where the highest TCE contaminant extraction occurs. The following information suggests remaining source mass upgradient of the LF-2 P&T system coupled with flow rates below the redesign rate are limiting the LF-2 system’s effectiveness: 1) the high concentration rebound in well LC-202, located upgradient of LF-2 system between NAPL area 1 and 2, from 110 µg/L (2011) to 580 µg/L (2016), 2) the statement in the 2017 Draft Final SMIS that the existence of potential remaining source areas at LF-2 contributing to the Logistics Center TCE groundwater plume is unknown, 3) average annual flow rates between 575 gpm and 700 gpm are below the LF-2 redesign flow rate of 800 gpm.

5.1.5.1.2 Operations and Maintenance

Operation and maintenance of the groundwater remediation at SLA P&T and the I-5 P&T systems is ongoing and there are no indications of any difficulties with remedy implementation. Treatment system downtime has been limited, and the air strippers are removing contamination to meet the treatment standards. Since March 2015, the I-5 system was taken offline twice per week for discharge pump strainer cleaning. Each cleaning event required a shutdown of approximately one hour. In late 2015, USACE began designing a system to improve solids settling in the tower sump (Versar, 2016).

5.1.5.1.3 Opportunities for Optimization

Annual average pumping rates have been below the design rate particularly for LF-2. It is recommended that the average annual pumping rate be near the modeled recommended pumping rate in order to meet capture requirements for each of the plumes.

It is unclear if previous modeling has included the pumping rates of the Madigan production wells (as well as other water supply wells shown on **Figure 3-1**) that are not part of the SLA system to determine if there is a detrimental impact to plume containment over time. Any future modeling efforts at the Logistics Center should document the inclusion of these production wells.

In addition, it is recommended to sample monitoring well LC-80D annually to monitor groundwater concentrations in the SLA west/northwest of the plume.

The 2012 FYR report included the following statement:

> *Groundwater monitoring data also suggests that the monitoring well network is limited in its ability to assess TCE concentrations east of PW-1 where the highest TCE contaminant extraction occurs. In the area of PW-1, groundwater monitoring and statistical analysis and perhaps an additional monitoring well in this area can help make the determination whether an additional extraction well is needed. To optimize the system, a capture zone analysis for the Landfill 2 system is recommended to ensure that the groundwater extraction and treatment system, as currently configured is completely capturing the TCE plume.*

Based on this FYR, it was unclear if this recommendation was considered but not implemented. Given the continuing operational history and high concentrations at PW-1, the capture zone analysis should be completed. The results of the modeling report for the I-5 system assumed that the LF-2 source was cut off in 2006. If this is not the case and if concentrations at the hot spot (LC-202) indicate a rebound and PW-1 does not effectively capture contaminants migrating from the landfill, then the long-term assumptions for the I-5 predictive modeling may not be accurate.

To optimize the system, a capture zone analysis for the LF-2 system is recommended to ensure that the groundwater extraction and treatment system, as currently configured is completely capturing the TCE plume, especially on the eastern portion of the plume. A capture zone analysis for the LF-2 system is outlined in the 2017 Draft Final SMIS.

5.1.5.1.4 Early Indicators of Potential Issues

As noted in the 2012 FYR:

> *Continued monitoring of the groundwater plume in this area with continued emphasis on the contaminant trends in the offsite Tillicum area is recommended. Lastly, if trend data continue to support an increasing trend near LC-225, another sentinel well is recommended between LC-225 and BC-1.*

Although no increasing trend was noted at LC-225, concentrations in this well remain above the MCL. TCE concentrations in well LC-226, also downgradient of the I-5 system in the offsite area, increased to above the MCL since the last FYR. Although a captures zone study was recently conducted for the I-5 system, close monitoring of this well should be considered to evaluate if the system is achieving capture. Consideration should also be given to installing another sentinel well in lower Vashon.

5.1.5.1.5 Implementation of Land Use Controls and Other Measures

Annual inspections have been effective in enforcing the LUCs outlined in the most recent version of the LUC Plan (2016 Draft JBLM LUC Plan). The installation-wide LUC program (discussed in **Section 4.5.3**) restricts installation of new wells within the footprint of the TCE groundwater plume without an EPA-approved monitoring program and within the boundaries of JBLM. However, the portion of the groundwater plume that extends offsite (north of I-5) does not have a groundwater use restriction. Water extracted from existing water supply wells within or near the Logistics Center boundary (Well 12A, 12B, 13, and MAMC-4) are currently being monitored for TCE and were found compliant (**Section 4.5.3**). As shown in **Figure 4-1**, land use has been restricted to non-residential in the area between LF-2 and the I-5 P&T system. The area in the vicinity of LF-2 has additional LUCs that prevent both unplanned excavation of contaminated soil and training access and require maintenance of a boundary fence with signs. The site inspection confirmed these LUCs are in place and functioning as intended by the LUC Plan.

5.1.5.2 Question B

Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Yes. There have been changes to risk assessment methods, exposure assumptions, and toxicity factors, but these do not call the protectiveness of the remedy into question. As shown on **Table 3-1**, chemical-specific ARARs have not changed since the original risk assessment, with the exception of the surface water cleanup goal for TCE. Comparison of cleanup levels to current Regional Screening Levels (RSLs) indicate that risks fall within acceptable ranges (**Table 3-1** and **Appendix 5**). The RAOs for preventing exposure of human and ecological receptors to contaminated groundwater remain valid. Overall, no changes have occurred that call the protectiveness of the remedy into question.

Changes in Risk Assessment Methods and Exposure Assumptions

A number of changes in risk assessment methods and exposure assumptions have taken place since the original risk assessment for the Logistics Area was performed. These changes are summarized in **Appendix 5**. These changes have not been significant enough to call into questions the protectiveness of the remedy.

Changes in Toxicity Values

Changes in toxicity values for chemicals evaluated in the Logistics Center risk assessment are presented in **Appendix 5**. The effects of these changes are not significant enough to call into questions the protectiveness of the remedy.

Changes in ARARs and TBCs (RSLs)
For groundwater, primary MCLs are identified as ARARs. The RGs for groundwater were based on the MCLs in place at the time of the ROD. The RGs were compared to current MCLs in **Table 3-1** as well as the State MCL. These values have not changed and are the same as the RG. The VOCs 1,1,1-trichloroethane (1,1,1-TCA) and vinyl chloride are mentioned in the ROD, but do not have an RG established. The ROD / DD specified a RG of 80 µg/L for TCE in surface water and listed cis-DCE as a COC in surface water but did not provide a corresponding RG. A comparison of RSLs to RGs is provided in **Table 3-1** and for instances where the RSL is lower than the RG, an evaluation was made to determine whether this risk is acceptable (**Appendix 5**). Based on this review, there is no change with respect to the protectiveness of the remedy.

Changes in RAOs
The primary remedial action objective is to restore all aquifers to drinking water status. The selected remedy prevents exposure to groundwater contaminants by human and ecological receptors, and minimize migration of contamination. By eliminating unacceptable risks, the remedy in concert with the RAO ensures the remedy remains protective of human health and the environment until the contaminated groundwater is restored to its designated use.

Emerging Contaminants

PFASs:
The presence of PFASs at or near the Logistics Center has not been evaluated. The Logistics Center's pump and treat systems have potential to intercept groundwater containing PFASs, whether a result of historical contamination associated with the Logistics Center or broader PFASs contamination at JBLM which will be further defined through the SI process (discussed in **Section 3.6.1**). If PFASs are present above the LHA level, and treatment systems are not configured to adequately treat PFASs prior to discharging, protectiveness may be affected. At the Logistics Center, the treated discharge from the three pump and treat systems is routed to various locations for beneficial reuse and then to infiltration galleries (LF-2 and I-5) and an infiltration pond (SLA) as depicted on **Figures 5-2**, **5-3**, and **5-4**. With the I-5 infiltration gallery positioned near the JBLM boundary, reinjection of groundwater with PFASs above the LHA level could result in redistribution of PFASs. Therefore, due to the unknown presence of PFASs at the influent and effluent of the pump and treat systems and corresponding discharge locations, a protectiveness determination cannot be made until further information is obtained.

1,4-Dioxane:
Groundwater samples were collected from the Logistics Center and analyzed for 1,4-dioxane between 2004 to 2005. 1,4-Dioxane was not detected above the Practical Quantitation Limit (PQL) at the time of 5 µg/L. The data were not available for review. The 2015 MTCA Method B limit for 1,4-dioxane has been lowered to 0.44 µg/L, which is based on a 10^{-6} cancer risk. Cancer risks from 1,4-dioxane occurring below the PQL do not exceed 1.2×10^{-5}, which falls well within the "acceptable" cancer risk range. Therefore, 1,4-dioxane, if present below the PQL, would not call the protectiveness of the remedy into question.

5.1.5.3 Question C

Has any other information come to light that could call into question the protectiveness of the remedy?

No.

5.1.5.3.1 Ecological Risks

Surface water samples have been collected from Murray Creek (SW-MC-07 [last sample 2015], SW-MC-08 [2016] and SW-MC-09 [2015]). The surface water sample results have remained below the surface water quality criteria with the 2016 SW-MC-08 sample result an estimated 0.1 µg/L for TCE.

5.1.5.3.2 Natural Disasters

No natural disasters have occurred that could call the protectiveness of the remedy into question.

5.1.5.3.3 Any Other Information That Could Call Into Question the Protectiveness of the Remedy

No other information was discovered during the review period that could call the protectiveness of the remedy into question.

5.1.5.4 Summary of Technical Assessment

The remedy has been implemented and is operating as intended by the ROD, ESD and DDs. Groundwater and surface water monitoring have been conducted to evaluate the effectiveness of the treatment systems. While the I-5 and SLA P&T systems are functioning as designed, O&M reports indicate overall reduced effectiveness of select extraction wells at LF-2. The potential presence of PFASs within groundwater intercepted by the pump and treat systems, whether as a result of Landfill 2 or broader installation-wide PFASs contamination, poses the risk of redistributing PFASs at points of reinjection and in some cases near the installation boundary. The presence of PFASs must therefore be evaluated before protectiveness determination can be made. Annual LUC inspections have ensured LUCs remain effective at restricting potential exposure to contaminated groundwater and soil at the Logistics Center. However, a groundwater use restriction does not exist for the portion of the plume outside the JBLM boundary and should be incorporated into the JBLM LUC Plan. None of the LUC inspection results have identified an issue which would impact the protectiveness of the remedy. Exposure assumptions made in the ROD remain valid and no changes to risk assessment, toxicity data, or cleanup levels have occurred which impact the protectiveness of the remedy.

5.2 Illicit PCB Dump Site (FTLE-46)

5.2.1 Background: Illicit PCB Dump Site

The approximately 1.4 -acre-site is located in a forested and remote portion of the operational range area in Training Area 11 (**Figure 4-1**). The dumping of PCBs and trichlorobenzenes by an unknown person was discovered by a timber contractor in 1983.

The current and anticipated future land use at the site is restricted within the JBLM operational range area.

5.2.1.1 Site Chronology: Illicit PCB Dump Site

Table 5.2-1: Chronology of Site Events

Event	Date
Interim Removal Action: Soil removal, cap, and fence installation	1983-1984
Remedial Investigations	1994
Groundwater Monitoring	1994-2000
Decision Document	2000
Decision Document to obtain USEPA concurrence (Needed because USEPA did not comment on the 2000 DD)	2006
Implementation of LUCs	2008
Final Draft Technical Memo (formal documentation of RI/FS)	2010
Preliminary Closeout Report (documents Operational and Functional)	2015
Five-Year Reviews	2002, 2007, 2012
Annual LUC Inspections	2011-2015

5.2.1.2 Initial Response

Initial response included an emergency removal of 1869 tons of PCB contaminated soil in 1983. Excavations were targeted at soils with concentrations in excess of 50 mg/kg total PCBs, the established cleanup goal recommended by Ecology. The 50 mg/kg total PCBs requirement was met with the exception of two small areas where soils with PCB concentrations of 280 and 390 mg/kg were not removed. That action was followed by installation of a two to three-foot, low-permeability clay cap and perimeter fence in 1984. A total of 18 groundwater monitoring wells were installed and eight groundwater monitoring events were conducted from 1994-1995 and from 1999-2000. PCBs and trichlorobenezene were not detected in groundwater samples.

5.2.1.3 Basis for Taking Action

Although there are no complete exposure pathways at the capped and fenced site, ongoing action (i.e., cap maintenance and land use controls) continues because PCBs were present in soil in 1983 at concentrations above residential and industrial cleanup levels for the potential direct contact pathway.

5.2.2 Remedial Actions: Illicit PCB Dump Site

5.2.2.1 Remedy Selection

Groundwater impacts are not a concern at the Illicit PCB Dump. In addition, direct soil contact is prevented by a low-permeability clay cap. The RAO for this site is prevention of direct human contact to the contaminated soils.

A DD dated December 2000 included the Illicit PCB Dump. LUCs were chosen as the selected remedy by the Army; however prior to the DD remedial actions included excavation of PCB contaminated soils, installation of a low-permeability clay cap, construction of fencing around capped area, and the installation of groundwater monitoring wells.

A 2006 DD (Fort Lewis, 2006) was written to serve as a vehicle to provide finality on the selected remedy since the remedy described in the December 2000 DD was contingent upon results of additional groundwater monitoring data. This site is included in the 2014 Final Draft Technical Memorandum (KEMRON, 2010a) to formally document the selected remedies for all non-NPL CERCLA sites that were not included in the 1990 Logistics Center ROD.

The LUCs consist of preventing residential land use, preventing active training access, preventing unplanned excavations in the capped and fenced areas, and providing for maintenance of the cap and fence at the site. USEPA concurred with the remedy presented in the 2006 DD in an e-mail dated January 19, 2005 as summarized in the USEPA-authored 2015 Preliminary Close Out Report (USEPA, 2015c)

5.2.2.2 Remedy Implementation

A LUC Plan was prepared by the Army and approved by USEPA in September 2007. The LUC's were implemented in 2008 and incorporated into the Draft 2016 JBLM LUC Plan. The 2015 Preliminary Closeout Report documents completion of construction activities and achievement of operational and functional for various sites including the Illicit PCB Dump Site.

5.2.2.3 Operation and Maintenance

The JBLM staff annually conducts routine monitoring and reporting of the LUCs described in the Draft 2014 JBLM LUC Plan. The routine monitoring consists of interviews with staff responsible for maintaining LUC overlays and visual field inspection of areas where LUCs apply. The JBLM LUC Monitoring Checklist is used to document the monitoring and is submitted to USEPA and Ecology for review. A copy of the LUC checklist is included in **Appendix 3.**

Site specific LUCs are in effect as documented in the 2012, 2013, 2014, and 2015 annual JBLM CERCLA LUC Checklists. The checklists documented that LUCs have successfully prevented residential land use, active training access, and unplanned excavations in the capped and fenced areas. The cap and fence at the site have also been maintained and signs posted around the perimeter of the fence. These observations were confirmed during the site visit. The annual inspections noted the presence of an invasive plant, Scotch's Broom, growing on the cap; however it does not appear to be affecting the integrity of the cap. The site-specific LUCs have been properly maintained as evidenced by the annual inspection checklists and confirmed during the FYR site visit.

5.2.3 Progress Since Last Five-Year Review: Site 180

The following is the protectiveness statement from the 2012 FYR for the Illicit PCB Dump Site:

> *The remedies at LF 4, SRCPP, Illicit PCB Dump Site, LF 1, Battery Acid Pit, DRMO Yard, IWTP, and Pesticide Rinse Area are protective of human health and the environment. LUCs have been implemented at all these sites and have been effective*

in limiting exposure to site contaminants. Groundwater monitoring at LF 1 and LF 4 has demonstrated no further impact or diminishing impact by site contaminants.

No issues or recommendations were identified in the previous FYR and no additional actions have occurred at the Illicit PCB Dump Site since the previous FYR.

5.2.4 Document and Data Review: Illicit PCB Dump Site

5.2.4.1 Document Review

Key installation-wide documents reviewed for this FYR can be found in **Section 3.5**. Site-specific documents reviewed include:

Fort Lewis, 2000. Decision Document for the Storm Water Outfalls/Industrial Wastewater Treatment Plant, Pesticide Rinse Area, Old Fire Fighting Training Pit, Illicit PCB Dump Site, and the Battery Acid Pit. Fort Lewis, WA. December.

Fort Lewis, 2006. Decision Document for Selected Remedy, Illicit PCB Dump Site, Fort Lewis, WA. April.

Kemron, 2010. Final Draft Technical Memorandum Fire Training Pit, Park Marsh, Pesticide Rinse Area, Illicit PCB Dump, Landfill 1, Explosive Ordnance Demolition Site 62. October.

5.2.5 Technical Assessment: Illicit PCB Dump Site

5.2.5.1 Question A

Is the remedy functioning as intended by the decision documents?

Yes.

5.2.5.1.1 Remedial Action Performance

Prior to the 2000 DD, response actions have included excavation, cap and perimeter fence installation, and groundwater monitoring which has been discontinued. The LUCs are ongoing and consist of preventing residential land use, preventing active training access, preventing unplanned excavations in the capped and fenced areas, and providing for maintenance of the cap, fence, and signs at the site. Annual LUC inspections and FYR inspection indicated the fence and signs are being maintained.

5.2.5.1.2 Operations and Maintenance

LUCs are the only active component of the remedy.

5.2.5.1.3 Opportunities for Optimization

No opportunities for optimization were identified during this FYR.

5.2.5.1.4 Implementation of Land Use Controls and Other Measures

The JBLM staff conducts annual monitoring and reporting of the LUCs described in the Draft 2014 JBLM LUC Plan. Site specific LUCs are in effect and are properly maintained as documented in the 2012, 2013, 2014, and 2015 annual JBLM CERCLA LUC Checklists. LUCs consist of preventing residential land use, preventing active training access, preventing unplanned excavations in the capped and fenced areas, and providing for maintenance of the cap, fence, and signs at the site.

5.2.5.1.5 Early Indicators of Potential Issues

No early indicators of potential issues were identified during this FYR.

5.2.5.2 Question B

Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Yes. The exposure assumptions, toxicity data, cleanup levels (DD's did not identify COCs or cleanup levels), and remedial action objective (prevent direct contact with contaminated soils) at the time the remedy was selected is still valid. Thus, no changes have occurred that call the protectiveness of the remedy into question.

Changes in Exposure Pathways: Maintenance of LUCs represents the only remaining component of the site remedy at the Illicit PCB Dump Site. There have been no changes in the physical condition of the site since cap installation. The site RAO is to prevent direct human contact to contaminated soils and the LUCs prevent this exposure pathway. There have been no changes to the exposure assumptions for the Illicit PCB Dump Site.

Changes in Toxicity, Cleanup Levels, Standards to be Considered, and Risk Assessment Methodologies: No COCs or cleanup standards were identified in the 2000 or 2006 DD for the Illicit PCB Dump Site. No cleanup ARARs were identified in the DD. The risk evaluation was not available for review; however updated RSLs and MTCA values for PCBs are unlikely to affect the protectiveness of the remedy under an industrial land use scenario.

5.2.5.3 Question C

Has any other information come to light that could call into question the protectiveness of the remedy?

No.

5.2.5.3.1 Ecological Risks

No new information concerning ecological risks has been found that could call the protectiveness of the remedy into question.

5.2.5.3.2 Natural Disasters

No natural disasters have occurred that could call the protectiveness of the remedy into question.

5.2.5.3.3 Any Other Information That Could Call Into Question the Protectiveness of the Remedy

No other information has come to light that could call into question the protectiveness of the remedy.

5.2.5.4 Summary of Technical Assessment

Excavation, cap and fence installation has been completed and groundwater monitoring has been discontinued in accordance with the DD. LUCs have been implemented and inspected annually and remain protective of human health and the environment. None of the LUC inspection results have identified issues which impact the protectiveness of the remedy. The LUCs prevent residential land use, active training, and unplanned excavation. Exposure assumptions made in the DD remain valid and no changes to risk assessment, toxicity data, or cleanup levels have occurred which impact the protectiveness of the remedy.

5.3 Landfill 1 (FTLE-54)

5.3.1 Background: Landfill 1

The approximately 15-acre Landfill 1 (LF-1) was reportedly used for disposal of solid waste between 1946 and the early 1970s. The site is located in the southern portion of the Cantonment Area, approximately ½ mile southwest of Gray Army Airfield (**Figure 4-1**).

The investigation chronology includes installation of four MWs in 1984 around the perimeter of the landfill, site investigations in 1988 and 1994, installation of seven additional MWs in 1995, and groundwater monitoring events conducted from 1997 to present day.

LF 1 is located in an area designated for maintenance in the Lewis-Main Master Plan. The main portion of the landfill is currently not in use and has vegetation growing on the cap. Paved parking lots are constructed over former open pit dumping areas. Future land use for the site may include development of recreational ball fields. The current and anticipated future land use designated for LF 1 in the Lewis-Main Master Plan is industrial/maintenance.

5.3.1.1 Site Chronology: Landfill 1

Table 5.3-1: Chronology of Site Events at Landfill 1

Event	Date
Site Investigation – Monitoring Well Installation	1984-1995
Draft Decision Document	2004
Final Groundwater Monitoring Plan	2004
Decision Document to obtain USEPA concurrence (Needed because USEPA did not comment on the 2000 DD)	2006
Implementation of LUCs	2008
Final Draft Technical Memo (formal documentation of RI/FS)	2010
Preliminary Closeout Report (documents Operational and Functional)	2015
Five-Year Reviews	2002, 2007, 2012
Annual LUC Inspections	2011-2015

5.3.1.2 Basis for Taking Action

Monitoring well installation around the perimeter of LF-1 revealed the presence of TCE at two monitoring wells adjacent to the landfill and at concentrations above the MCL. A screening-level risk assessment was conducted in 1994 and concluded that the only potentially complete exposure pathway for human and ecological receptors is the human ingestion/inhalation of VOCs in groundwater. However, the only potential current drinking water receptor is the Lewis-Main Well 14 (**Figure 3-1**). Well 14 is located approximately 1200 feet northeast of the landfill (cross-gradient from the regional direction of groundwater flow) and is screened in the deeper SLA. As described in **Section 4.5.3**, this well is subject to water quality monitoring through the WDOH. The only COC at the site is TCE in groundwater.

5.3.2 Remedial Actions: Landfill 1

5.3.2.1 Remedy Selection

A DD dated April 2006 (Fort Lewis, 2006b) identified groundwater monitoring and LUCs as the selected remedy. This site is included in the Final Draft Technical Memorandum (KEMRON, 2010a) to formally document the selected remedies for all non-NPL CERCLA sites that were not included in the 1990 Logistics Center ROD (EPA, 1990b).

RAOs include:

- Preventing inhalation and ingestion by human and ecological receptors of the VOCs in groundwater underneath and surrounding the landfill.
- Preventing direct exposure to landfill wastes.

Because TCE concentrations in groundwater surrounding the landfill were above the MCL, the selected remedy for the site includes the following actions:

- Implement LUCs on land use. A LUC plan would be developed that restricts land uses within the landfill boundary.
- Implement LUCs on groundwater use. The LUC plan would also prevent the installation of new water supply wells within 1,000 feet of the landfill boundary.
- Conduct long-term groundwater monitoring. Conduct annual groundwater monitoring as described in the April 2004 *LF 1 Groundwater Monitoring Plan*, as amended.

EPA concurred with the selected remedy in the 2004 Draft DD and 2004 *Final LF 1 Groundwater Monitoring Plan* (Bussey, 2004) in an e-mail dated April 20, 2004. The above remedy was implemented by the Army in 2008.

5.3.2.2 Remedy Implementation

Fourteen monitoring wells have been installed at LF 1, and the Groundwater Monitoring Plan for LF 1 has been periodically amended to reflect changes in sample frequency and optimization of the well network.

LUCs were implemented in 2008 through a LUC Plan per the DD and include restrictions to installing new water supply wells within 1,000 feet of the landfill boundary, prevention of residential land use and unplanned excavation of contaminated soils (**Figure 4-1**).

5.3.2.3 Operation and Maintenance

In accordance the 2016 Groundwater Monitoring Plan for LF-1, the groundwater monitoring network was optimized to formally discontinue sampling from 10 monitoring wells that were on a five-year sampling frequency. Annual groundwater sampling and analysis for VOCs (the only COC is TCE) is conducted at the four remaining wells shown on **Figure 5-9** (95-LF1-11, 84-CD-LF1-4, 84-CD-LF1-3, 95-LF1-10). All of the wells are screened in the Upper Vashon Aquifer. Two of the wells, 95-LF-10 and 95-LF1-11 have been consistently below the RG of 5 µg/L for TCE. The remaining two wells had a maximum concentration of approximately 12 µg/L (84-CD-LF1-3) and 5.6 µg/L (84-CD-LF1-4) within the last five years. The maximum detected TCE concentration in May 2016 was 5.6 µg/L at 84-CD-LF1-4. Historical TCE time series concentration data associated with these four wells are shown on **Figure 5-10**.

Site specific LUCs are in effect as documented in the 2012, 2013, 2014, and 2015 annual JBLM CERCLA LUC Checklists. The checklists documented that LUCs have successfully prevented residential land use and unplanned excavations within the boundary of the landfill. These observations were confirmed during the site visit.

5.3.3 Progress Since Last Five-Year Review: Landfill 1

The protectiveness statement from the 2012 installation-wide FYR stated:

> *The remedies at LF 4, SRCPP, Illicit PCB Dump Site, LF 1, Battery Acid Pit, DRMO Yard, IWTP, and Pesticide Rinse Area are protective of human health and the environment. LUCs have been implemented at all these sites and have been effective in limiting exposure to site contaminants. Groundwater monitoring at LF 1 and LF 4 has demonstrated no further impact or diminishing impact by site contaminants.*

No issues or recommendations were identified in the previous FYR report. No additional actions have occurred at LF-1 since the previous FYR.

5.3.4 Document and Data Review: Landfill 1

5.3.4.1 Document Review

Key installation-wide documents reviewed for this FYR can be found in **Section 3.5**. Site-specific documents reviewed include:

JBLM, 2016. Final Groundwater Monitoring Plan, Landfill 1. February.

Fort Lewis. 2006. Decision Document for Selected Remedy, Landfill 1, Fort Lewis, WA, April.

KEMRON Environmental Services, Inc. 2010. Final Draft Technical Memorandum, Fire Training Pit, Park Marsh, Pesticide Rinse Area, Illicit PCB Dump, Landfill 1, Explosive Ordnance Demolition Site 62, JBLM, WA. October.

Pacific Northwest Laboratory (PNL). 1990. Limited Site Investigation of Landfills 1 and 4, Fort Lewis, Washington. (PNC-7613, UC-903). August 1990.

Sealaska Environmental (SES), 2015. 2014 Annual Groundwater Monitoring Report, Landfill 1. March.

Sealaska Environmental (SES), 2016. 2016 Regulator Draft Annual Groundwater Monitoring Report, Landfill 1. November.

Versar, 2014. 2011 Annual Groundwater Monitoring Report, Landfill 1. January.

Versar, 2014. 2012 Annual Groundwater Monitoring Report, Landfill 1. January.

Versar, 2014. 2013 Annual Monitoring Report, Logistics Center Remedial Action Monitoring Program. April.

USEPA, 2015. Preliminary Close Out Report, Logistics Center. September.

5.3.4.2 Data Review and Evaluation

The direction of groundwater flow is approximately to the east/southeast due to local topography. This is in contrast to the western/northwestern direction of the JBLM-wide Upper Vashon aquifer. Only two monitoring wells are currently above the MCL with a 2016 maximum concentration of 5.6 µg/L. The historical maximum concentration since monitoring began in the late 1980s is 24.4 µg/L.

The 2012 FYR stated that annual groundwater monitoring will continue until all VOC concentrations are below MCLs for three consecutive years or until the year 2017 as long as VOC concentrations are stable or declining. Conducting groundwater monitoring until 2017 represents achieving the thirty (30) years of post-closure monitoring as required under RCRA for landfill closure since monitoring first began in 1988. Based on a review of the statistical analyses and time series concentration charts in the two monitoring wells with TCE above the RG (**Figure 5-10**), concentrations appear to be decreasing and hovering near the RG.

There have been concerns expressed that the existing monitoring network does not fully monitor the eastern/southeastern extent of the plume. During the September 2016 FFA meeting, JBLM discussed installing two new monitoring wells downgradient of 95-LF1-11 and 84-CD-LF1-3 to confirm the extent of TCE downgradient of LF-1. Presumably, if these wells confirm the conceptual site model, it would bolster a recommendation to discontinue long-term monitoring at LF-1. This proposal would be formalized in the 2016 groundwater monitoring report.

5.3.5 Technical Assessment: Landfill 1

5.3.5.1 Question A

Is the remedy functioning as intended by the decision documents?

Yes.

5.3.5.1.1 Remedial Action Performance

Groundwater monitoring program has been implemented and periodically updated consistent with the groundwater monitoring plan. TCE is present above the RG at only two of the original 14 wells. Trend analyses and time series concentration charts indicate concentrations are decreasing (historically statistically significant at 84-CD-LF1-4 and not statistically significant at 84-CD-LF-3) and are currently near the RG.

5.3.5.1.2 Operations and Maintenance

Groundwater monitoring has been conducted in accordance with the 2013 Sampling and Analysis Plan and the updated 2016 Groundwater Monitoring Plan.

5.3.5.1.3 Opportunities for Optimization

No opportunities for optimization were identified during this FYR.

5.3.5.1.4 Implementation of Land Use Controls and Other Measures

The JBLM staff conducts annual monitoring and reporting of the LUCs described in the Draft 2014 JBLM LUC Plan. Site specific LUCs are in effect and are properly maintained as documented in the 2012, 2013, 2014, and 2015 annual JBLM CERCLA LUC Checklists. LUCs consist of preventing residential land use, unplanned excavations within the boundaries of the landfill and installation of new drinking water wells within 1,000 feet of the landfill boundary.

5.3.5.1.5 Early Indicators of Potential Issues

No early indicators of potential issues were identified.

5.3.5.2 Question B

Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Yes. There have been changes to risk assessment methods, exposure assumptions, and toxicity factors, but these do not call the protectiveness of the remedy into question. ARARs have not changed since the original risk assessment (**Table 3-1**). Comparison of cleanup levels to current Regional Screening Levels (RSLs) indicate that risks fall within acceptable ranges. The RAOs for preventing exposure of human and ecological receptors to contaminated soil and groundwater are valid. Overall, no changes have occurred that call the protectiveness of the remedy into question.

Changes in Risk Assessment Methods and Exposure Assumptions

A number of changes in risk assessment methods and exposure assumptions have taken place since the 1994 assessment for the LF-1 performed by Woodward and Clyde Consultants. These changes are summarized in **Appendix 5**. These changes have not been significant enough to call the protectiveness of the remedy into question.

The potential for VI was considered for buildings near monitoring wells with TCE present above 5 µg/L within the last five years. The maximum TCE concentration of 12 µg/L (**Figure 5-10**) was observed at monitoring well 84-CD-LF1-3 between 2011 and 2012 and has since been declining. This concentration was inputted into USEPA's VI screening level calculator (Version 3.5.1, May 2016 RSLs) under a commercial exposure scenario. The carcinogenic risk level was $2x10^{-6}$ and within the acceptable risk range (i.e., 10^{-4} to 10^{-6}). The non-carcinogenic hazard quotient was 0.6, below the target HQ of 1.0. Therefore, the potential for VI does not affect current or future protectiveness.

Changes in Toxicity Values
Changes in toxicity values for chemicals evaluated in the 1994 WCC risk assessment are presented in **Appendix 5**. The effects of these changes do not call the protectiveness of the remedy into question.

Changes in ARARs and TBCs
For groundwater, the RG for TCE of 5 μg/L was driven by the MCL which has not changed. In Table 3-1,the RSL calculator shows that the cancer risk posed by exposure to TCE at the RG, which is set at the MCL of 5 μg/L, is $1x10^{-5}$, well within the "acceptable" risk range of 10^{-6} to 10^{-4}. The HQ of 1.8 at the TCE MCL indicates the possibility of fetal cardiac malformations if a pregnant resident should be exposed to the groundwater. Site restrictions that prevent installing of new drinking water wells prevent exposure and thus there is no change with respect to the protectiveness of the remedy.

Changes in RAOs
The RAOs remain valid as they prevent human and ecological receptors from exposure to groundwater contaminants. By eliminating unacceptable risks, the RAOs ensure the remedy remains protective of human health and the environment until the contaminated groundwater is restored to its designated use.

5.3.5.3 Question C

Has any other information come to light that could call into question the protectiveness of the remedy?

No.

5.3.5.3.1 Ecological Risks

No additional information has come to light that would affect the protectiveness of the remedy with respect to ecological receptors.

5.3.5.3.2 Natural Disasters

No natural disasters have occurred that could call the protectiveness of the remedy into question.

5.3.5.3.3 Any Other Information That Could Call Into Question the Protectiveness of the Remedy

No other information was discovered during the review period that could call the protectiveness of the remedy into question.

5.3.5.4 Summary of Technical Assessment

Groundwater monitoring has been conducted in accordance with DDs and Groundwater Monitoring Plan. TCE is present above the RG at only two of the original 14 wells. Times series concentration charts (some with data sets beginning in 1988) and statistical analyses indicate these concentrations are decreasing and are currently near the RG. LUCs have been implemented and inspected annually and remain protective of human health and the environment. None of the LUC inspection results have identified issues which impact the protectiveness of the remedy. The LUCs prevent residential land use, unplanned excavation, and installation of drinking water wells within 1,000 feet of the landfill boundary. Exposure assumptions made in the DD remain valid and no changes to risk assessment, toxicity data, or cleanup levels have occurred which impact the protectiveness of the remedy.

5.4 Battery Acid Pit (FTLE-16), DRMO Yard (FTLE-31), IWTP (FTLE-51)

The Battery Acid Pit, Defense Reutilization and Marketing Office (DRMO) Yard, and Industrial Wastewater Treatment Plant (IWTP) are all located within the Logistics Center and were identified within the Logistics Center ROD as non-NPL CERCLA sites requiring additional characterization. Subsequent investigations and decision documents determined land use monitoring to prevent residential development (all three sites) and institutional controls to prevent excavation and maintain the cap (Battery Acid Pit) will protect of human health and the environment under the industrial land use setting.

5.4.1 Background: Battery Acid Pit

The approximately 5-foot by 8-foot by 10-foot deep pit was used from 1971 to 1976 for discarding electrolyte solutions from vehicle batteries. The site is located within the northwest portion of the Logistics Center south of Building 9580 and adjacent to former Building 9589 (**Figure 4-1**).

Soil investigations of the Battery Acid Pit were conducted in 1986 and during the 1988 Logistics Center RI. The RI results for the Battery Acid Pit and other potential source areas within the Logistics Center indicated that soil contamination did not present a threat to public health and the environment. However, the selected remedy in the Fort Lewis Logistics Center 1990 ROD (USEPA, 1990) included the performance of confirmation sampling to ensure that all remaining sources of soil contamination are identified and characterized.

Site investigations were conducted at the Battery Acid Pit in 1993 and 1995. The concern was that lead could be present in soil that may pose a risk to site workers with the potential to leach to groundwater. The investigations determined elevated concentrations of total lead and low soil pH in the pit. Samples collected for TCLP analysis indicated the soil was below hazardous waste levels.

A health impact assessment was performed to evaluate direct exposures to on-site construction workers and exposure to adults 100 meters from the site. The assessment results are documented in the 2000 Decision Document and are summarized in **Section 5.4.1.1.3**.

The current and anticipated future land use designated for the site in the Lewis-Main Master Plan is industrial/maintenance.

5.4.1.1.1 Site Chronology: Battery Acid Pit

Table 5.4-1: Chronology of Site Events at Battery Acid Pit

Event	Date
Initial soil sampling	1986
Logistics Center RI	1988
Site included in the Logistics Center ROD as a potential groundwater contamination source (subsequently determined not to be a source)	1990
Logistics Center investigations	1993/1995
DD for several sites including the Battery Acid Pit	2000
DD to obtain USEPA concurrence (Needed because USEPA did not comment on the 2000 DD)	2006

Implementation of LUCs	2008
Five Year Reviews	2007 and 2012
Preliminary Closeout Report (documents Operational and Functional)	2015
Annual LUC Inspections	2011-2015

5.4.1.1.2 Initial Response: Battery Acid Pit

No pre-DD cleanup activities were completed at the Battery Acid Pit (FTLE-16)

5.4.1.1.3 Basis for Taking Action: Battery Acid Pit

A HHRA was performed for construction worker exposure via direct contact, inhalation, and ingestion along with adult exposure 100 meters from the site (assumed wind deposition of lead on soils, buildings, etc.). Calculated blood lead levels for all exposure scenarios were well below the USEPA recommended 10 µg/dL guideline, thus the site does not represent an unacceptable risk under the industrial/commercial use scenario. As a result, no further action other than paving the site with asphalt (which had been completed at the time of the evaluation) and monitoring of land use was recommended for the site.

The Army selected remedy for the Battery Acid Pit identified in the 2000 DD, and 2006 DD are discussed in Section 5.4.2.2.

5.4.1.2 Background: DRMO Yard

The approximately 33-acre DRMO Yard is an active industrial laydown yard for surplus materials to be recycled or reused. The site was evaluated because in May 1981 approximately 10-15 gallons of transformer fluid containing PCBs was spilled. The site is located in the southeast portion of the Logistics Center and immediately northwest of LF-2 (**Figure 4-1**).

Investigation activities included PCB confirmation soil sampling in 1986 and investigation during the 1988 Logistics Center RI. The RI results for the DRMO Yard and other potential source areas within the Logistics Center indicated that soil contamination did not present a threat to public health and the environment. However, the selected remedy in the Fort Lewis Logistics Center 1990 ROD (USEPA, 1990) included the performance of confirmation sampling to ensure that all remaining sources of soil contamination are identified and characterized.

In a 2000 study, surface soil locations with elevated contaminant concentrations were excavated, stockpiled, and sampled for waste characterization. The most significant result of this attempted soil removal action was the determination that excavation and off-site disposal was not a feasible remedial alternative since soil concentrations at the site are low.

The site is currently used as an active industrial laydown yard for surplus material to be recycled. The anticipated future land use designated for the site in the Lewis-Main Master Plan is industrial.

5.4.1.2.1 Site Chronology: DRMO Yard

Table 5.4-2: Chronology of Site Events at DRMO Yard

Event	Date
Soil Removal	1982
Interim Report, Groundwater Investigations	1986
Logistics Center Remedial Investigation	1988
Site included in the Logistics Center ROD as a potential groundwater contamination source (subsequently determined not to be a source)	1990
Limited Field Investigation Report (Woodward Clyde)	1995
Limited Field Investigation Report (Shannon and Wilson). Included a Human Health Screening Level Risk Assessment	2000
Field Report (Soil Removal Study)	2000
Installation Restoration Program Screening Level Risk Assessment	2005
Decision Document, DRMO Yard	2006
Implementation of LUCs	2008
Five Year Reviews	2007 and 2012
Preliminary Closeout Report (documents Operational and Functional)	2015
Annual LUC Inspections	2011-2015

5.4.1.2.2 Initial Response: DRMO Yard (FTLE-31)

A limited soil removal of approximately 15 cubic yards was completed in 1982. Subsequent sampling of excavated soil stockpiles indicated the soil could be returned to the excavation. No other pre-DD cleanup activities were completed at the DRMO Yard (FTLE-31).

5.4.1.2.3 Basis for Taking Action; DRMO Yard

Site investigations at the DRMO Yard were conducted in 1995 and 2000. Total petroleum hydrocarbons in the heavy oil range, total carcinogenic polycyclic aromatic hydrocarbons, and lead were present in soil in 1995 at concentrations above residential cleanup levels for the potential direct contact pathway.

A Human Health Screening Level Risk Assessment (HHSLRA) was conducted in 2000 as part of the investigations. The HHSLRA evaluated exposure scenarios for on-site industrial workers and current or future off-site residents. All human health risk calculations assumed the site would be capped with asphalt. No unacceptable risks were documented based on direct exposure to on-site industrial workers or groundwater ingestion by current or future off-site residents. The ecological risks were also considered insignificant based on the site’s industrial setting, lack of vegetation, and lack of ecological populations.

In 2005, the 2000 HHSLRA was reevaluated. The 2005 Screening Level Risk Assessment results are documented in the 2006 DD and are summarized in Section 10.1.2.3.

The 2000 HHSLRA was determined to no longer be adequate because: 1) the risk evaluation assumed approximately 95% of the site would be paved in the future (not implemented), 2) the risk evaluation was completed prior to revisions of Ecology's Model Toxics Control Act (MTCA) regulations in 2001, and 3) the potential leaching to groundwater pathway was not completely addressed.

The 2005 screening level risk assessment determined the only potentially complete and significant exposure pathway is the direct contact pathway under the commercial/industrial land use scenario. The potential direct contact pathway does not pose an unacceptable risk or hazard given the current and anticipated future land use; However, institutional controls are required by MTCA to ensure land use remains industrial because soil concentrations exceed the unrestricted use MTCA Method B levels for total PCBs, total cPAHs, TPH in the heavy oil range (TPH-HO), and lead.

The Army-selected remedy for the DRMO Yard identified in the 2006 DD is discussed in Section 10.2.

5.4.1.3 Background: IWTP

The approximately 1-acre Industrial Wastewater Treatment Plant (IWTP), also known as the Stormwater Outfall #7/Settling Basin, is located within a fenced portion of the Logistics Center Complex and consists of a collection sump and two settling basins (**Figure 4-1**). The IWTP began operating in 1954. The facility predominantly receives storm water runoff from nearby maintenance facilities. The IWTP also received floor washings from machine shops, paint spray booths, and rinsate from metal refinishing dip tanks of the Logistics Center. Effluent from the IWTP was discharged to a no-outlet evaporation/ percolation lagoon. From 1954 to the mid-1970s, sediment and sludges from the IWTP's evaporation/percolation lagoon were disposed of in Landfill No. 6. In the early 1990's the industrial discharges from the IWTP were rerouted to the sanitary sewer. The storm water settling basins were taken out of service in 2002 following construction of Outfall #7. The evaporation/percolation lagoon currently receives overflows from Outfall #7 only during very high intensity rainfall events. Up through 2010, no flow to the lagoons was noted. Outfall #7 is regulated under the Clean Water Act (CWA) with a National Pollutant Discharge Elimination System (NPDES) permit.

The following investigations have been conducted:

- **Logistics Center RI 1986 through 1988:** Investigation of the IWTP was conducted during a limited site investigation in 1986 and the 1988 Logistics Center RI. The RI results for the IWTP and other potential source areas within the Logistics Center indicated that soil contamination did not present a threat to public health and the environment. However, the selected remedy in the Fort Lewis Logistics Center 1990 ROD (USEPA, 1990) included the performance of confirmation sampling to ensure that all remaining sources of soil contamination are identified and characterized.
- **1993 Limited Field Investigation (LFI):** A LFI was conducted in 1993 to determine if Fort Lewis stormwater outfalls including Outfall #7 contributed metals, PAHs, and petroleum hydrocarbons to sediments in the receiving water bodies. The LFI findings supported a no further action recommendation for the stormwater outfalls including Outfall #7.
- **Outfall #7 Installation and Surficial Soil Sampling:** During 2001/2002 stormwater improvements at Outfall #7, approximately 80 cubic yards of petroleum impacted soil were removed; however confirmation samples were not collected. A 2002 limited SI for surface soil followed the Outfall #7 construction activity. Samples were analyzed for total metals, TPH,

VOCs, semi-volatile organic compounds (SVOCs), and TCLP metals. Results exceeded MTCA Method B/C for Leaching to Groundwater.

- **2007 Site Investigation** collected surface and subsurface soil samples to evaluate potential exposure pathways (Fort Lewis, 2007b). Soil samples were collected from seven test pits located in the ditch and former lagoon downstream of the IWTP. Various detections of TPH, cPAHs, and lead were above the MTCA Method A unrestricted use thresholds but below the MTCA Method C industrial thresholds. Select TPH and cPAHs concentrations were also above the MTCA threshold for potential leaching to groundwater.

The site is currently used for excess stormwater capacity during infrequent stormwater overflows from Outfall #7, an NPDES-regulated outfall installed in 2002 that replaced the IWTP lagoons. Future land use is expected to remain industrial.

5.4.1.3.1 Site Chronology: IWTP (FTLE-51)

Table 5.4-3: Chronology of Site Events at IWTP

Event	Date
Limited SI of surface soils and Outfall #7 effluent	1986
Logistics Center Remedial Investigation	1988
Site included in the Logistics Center ROD as a potential groundwater contamination source (subsequently determined not to be a source)	1990
Limited Field Investigation of Fort Lewis stormwater outfalls	1993
Decision Document for the Stormwater Outfalls/IWTP (and other sites)	2000
Soil removal associated with stormwater improvements	2001/2002
Site Investigation for the IWTP	2007
Draft Decision Document for Selected Remedy, IWTP	2007
Implementation of LUCs	2008
Five Year Reviews	2007 and 2012
Preliminary Closeout Report (documents Operational and Functional)	2015
Annual LUC Inspections	2011-2015

5.4.1.3.2 Initial Response: IWTP (FTLE-51)

The IWTP was included in the 1990 ROD (USEPA, 1990) for the Logistics Center as a potential TCE source of groundwater contamination. However, the IWTP was subsequently determined not to be a source, and it is now considered a non-NPL CERCLA Site. As discussed later in Section 10.2.1, a draft DD was prepared by the Army for the IWTP site in 2007. Prior to the draft 2007 DD, approximately 80 cubic yards of soil were removed during improvements to Outfall #7 in 2001/2002 (Section 10.1.3). No other pre-DD cleanup activities were completed at the IWTP (FTLE-51).

5.4.1.3.3 Basis for Taking Action IWTP

The screening level risk evaluation, based on MTCA criteria, concluded that there was no unacceptable risk based on the current and foreseeable industrial use of the area.

However, a no further action determination was not appropriate since contaminants are present in surface soil at concentrations above applicable cleanup levels for residential use. LUCs are needed to ensure the property is not used for residential purposes. The Army-selected remedy for the IWTP identified in the 2007 DD is discussed in Section 10.2.

5.4.2 Remedial Actions: Battery Acid Pit, DRMO Yard, IWTP

5.4.2.1 Remedy Selection

All three sites were included in the 1990 ROD (EPA, 1990) for the Logistics Center as a potential TCE source of groundwater contamination. The ROD did not include site-specific RAOs; however the primary RAO is to restore the unconfined aquifer to drinking water status. Investigations determined these sites were not potential sources of the Logistics Center groundwater VOC plume.

Battery Acid Pit

The Battery Acid Pit site was included in the 1990 ROD (EPA, 1990) for the Logistics Center as a potential source of groundwater contamination. The selected remedy included confirmation sampling at the site to identify and characterize all remaining sources of soil contamination. The Battery Acid Pit was subsequently determined not to be a source, and it is now considered a non-NPL CERCLA Site.

A DD dated December 2000 (Fort Lewis, 2000) included the Battery Acid Pit and several other sites. Maintenance of the existing pavement cap and institutional controls was the selected remedy identified in the 2000 DD. However, the USEPA January 7, 2000 letter provided in response to the 2000 DD omitted reference to the Battery Acid Pit. USEPA did not comment on the December 2000 selected remedy for the Battery Acid Pit due to the location of the site within the Logistics Center.

In April 2006, Army issued a DD (Fort Lewis, 2006) to satisfy the public comment requirement, select a remedy for the Battery Acid Pit site, and obtain concurrence from USEPA and U.S. Army Center for Promotion and Preventative Medicine. The DD identified LUCs to prevent residential land use and unplanned excavations of contaminated soils, maintenance of the asphalt cap, and five-year reviews as the appropriate remedy for this site. LUC requirements for the site are identified in the Draft Environmental Restoration Land Use Controls document (JBLM, 2014). USEPA provided concurrence with the selected remedy in an e-mail dated January 19, 2005; however no formal letter of concurrence was received by the Army.

As mentioned earlier in this section, the Battery Acid Pit was initially identified as a potential source area within the Logistics Center and was included in the 1990 Logistics Center ROD. The Army-selected remedy for all sites included in the 1990 ROD was to “perform confirmation sampling to ensure that all remaining sources of soil contamination have been identified and characterized.”

DRMO Yard

The DRMO Yard was included in the 1990 ROD (USEPA, 1990) for the Logistics Center as a potential source of groundwater contamination. The selected remedy included confirmation sampling at the site to identify and characterize all remaining sources of soil contamination. The DRMO Yard was subsequently determined not to be a source, and it is now considered a non-NPL CERCLA Site.

The 2006 DD (Fort Lewis, 2006) selected LUCs to prevent residential land use within the boundaries of the site and five-year reviews as the final remedy for the DRMO Yard. The LUC remedy requires consideration of the nature and extent of the site during future planning decisions and mitigation of potential impacts from the site as necessary before any proposed residential use. USEPA concurred with the selected remedy in an e-mail dated January 27, 2005. However, no formal letter of concurrence was received by the Army.

LUC requirements for the site are identified in the Draft Environmental Restoration Land Use Controls document (JBLM, 2014).

IWTP

The IWTP was included in the 1990 ROD (USEPA, 1990) for the Logistics Center as a potential source of groundwater contamination. The selected remedy included confirmation sampling at the site to identify and characterize all remaining sources of soil contamination. The IWTP was subsequently determined not to be a source, and it is now considered a non-NPL CERCLA Site.

A draft DD was prepared by the Army for the IWTP site in 2007. The DD (Fort Lewis, 2007) selected LUCs with five-year reviews as the final remedy for the site. The LUC remedy requires consideration of the nature and extent of the site during future planning decisions and mitigation of potential impacts from the site as necessary before any proposed residential use. However, the draft DD was not finalized pending preparation of an ESD for the site.

LUC requirements for the site are identified in the Draft Environmental Restoration Land Use Controls document (JBLM, 2014).

5.4.2.2 Remedy Implementation for the Battery Acid Pit, DRMO Yard, and IWTP

The 2015 Preliminary Closeout Report documented that selected remedies for sites within the Logistics Center, including the Battery Acid Pit, DRMO Yard, and IWTP, are considered operational and functional.

LUCs for the Battery Acid Pit, DRMO Yard, and IWTP have been implemented through the Land Use Control Plans (including various updates) and annual inspections described in **Section 4.5.**

5.4.2.3 Operation and Maintenance

The JBLM staff annually conducts routine monitoring and reporting of the LUCs described in the Draft 2014 JBLM LUC Plan. The routine monitoring consists of interviews with staff responsible for maintaining LUC overlays and visual field inspection of areas where LUCs apply. The JBLM LUC Monitoring Checklist is used to document the monitoring and is submitted to USEPA and Ecology for review. A copy of the LUC checklist is included in **Appendix 3.**

Site specific LUCs are in effect as documented in the 2012, 2013, 2014, and 2015 annual JBLM CERCLA LUC Checklists. The 2013 LUC checklist included a figure showing damaged asphalt at the Battery Acid Pit. Subsequent checklists did not note the damaged asphalt and FYR site inspection confirmed the asphalt had been repaired. No other specific issues were identified in the checklists. Land use has remained non-residential as summarized in **Section 4.5.3**.

5.4.3 Progress Since Last Five-Year Review: Battery Acid Pit, DRMO Yard, IWTP

The protectiveness statement from the last review for several JBLM site, including the Battery Acid Pit, DRMO Yard, and the IWTP stated:

> *The remedies at LF 4, SRCPP, Illicit PCB Dump Site, LF 1, Battery Acid Pit, DRMO Yard, IWTP, and Pesticide Rinse Area are protective of human health and the environment. LUCs have been implemented at all these sites and have been effective in limiting exposure to site contaminants. Groundwater monitoring at LF 1 and LF 4 has demonstrated no further impact or diminishing impact by site contaminants.*

No issues or recommendations specific to the Battery Acid Pit, DRMO Yard, and the IWTP were identified in the previous FYR report.

The previous FYR indicated that finalization of a LUC plan combining the individual plans for Lewis-Main (2007) and McChord Field (2010) was in progress. The 2014 Draft JBLM LUC Plan is scheduled to be finalized in 2016.

5.4.4 Document and Data Review: Battery Acid Pit, DRMO Yard, IWTP

5.4.4.1 Document Review

Key documents reviewed for this FYR can be found in **Section 3.5** and include the annual LUC checklists and LUC Plan. Site-specific documents reviewed include:

Fort Lewis, 2000. Decision Document for the Storm Water Outfalls/Industrial Wastewater Treatment Plant, Pesticide Rinse Area, Old Fire Fighting Training Pit, Illicit PCB Dump Site, and the Battery Acid Pit. Fort Lewis, WA. December.

Fort Lewis, 2006. Decision Document for Selected Remedy, Battery Acid Pit. Fort Lewis, WA. April.

Fort Lewis, 2006. Decision Document for Selected Remedy, Defense Reutilization and Marketing Office Yard. Fort Lewis, WA. April.

Fort Lewis, 2007a. Draft Decision Document for Selected Remedy, Industrial Wastewater Treatment Plant Site. Fort Lewis, WA. December.

[4]Fort Lewis, 2007b. Draft Site Investigation Report, IWTP site, Fort Lewis, WA. Fort Lewis IRP, December.

[4] Document was referenced but not reviewed.

Kemron, 2010. Final Draft Explanation of Significant Differences Logistics Center NPL Site. Joint Base Lewis McChord, WA. October.

USEPA, 1990. A Superfund Record of Decision: Fort Lewis Logistics Center EPA ID: WA7210090067 OU 01 Tillicum, WA. September.

5.4.5 Technical Assessment: Battery Acid Pit, DRMO Yard, IWTP

5.4.5.1 Question A: Battery Acid Pit, DRMO Yard, IWTP

Are the remedies functioning as intended by the decision documents?

Yes. The LUC sites are functioning in accordance with their DDs.

LUCs have been implemented as the remedy at the Battery Acid Pit, DRMO Yard, and the IWTP sites. Based on a review of all available information and site visits to confirm LUC implementation, all LUCs are functioning as intended. No installation development is encroaching onto these sites and threatening the selected remedy.

5.4.5.1.1 Remedial Action Performance

LUCs were the chosen remedy for the Battery Acid Pit, DRMO Yard, and the IWTP sites; no additional remedial actions have occurred at the sites. LUCs were determined to be protective of human health and the environment in the ROD based on the continued industrial land use of the sites. Land use at the sites has not changed, and the LUCs ensure risks to human health and the environment remain within acceptable limits. The remedy is functioning as intended by the decision documents.

5.4.5.1.2 Implementation of Land Use Controls and Other Measures

The LUCs are properly maintained and repair issues are identified. Deficiencies are noted during the annual LUC inspections and documented in the Annual Land Use Monitoring Checklists.

5.4.5.1.3 Early Indicators of Potential Issues

No early indicators of potential issues were identified during this FYR.

5.4.5.2 Question B: Battery Acid Pit (FTLE-16), DRMO Yard (FTLE-31), IWTP (FTLE-51)

Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

<u>Battery Acid Pit</u>

Yes. The exposure assumptions, toxicity data, cleanup levels (DD's did not identify COCs or cleanup levels), and remedial action objective (restore groundwater) at the time the remedy was selected are still valid. Thus, no changes have occurred that call the protectiveness of the remedy into question.

Changes in Exposure Pathways: Based on a review of the exposure pathways described in the HHRA (**Section 5.4.1.1.3**) and current land use, no changes in exposure pathways were identified.

Changes in Toxicity, Cleanup Levels, Standards to be Considered, and Risk Assessment

Methodologies: No COCs or cleanup standards were identified in either the 2000 or 2006 DDs for the Battery Acid Pit. No cleanup ARARs were identified in either DD. The health impact study (2000 DD) concluded that exposures of up to 2,300 mg/kg of lead did not pose unacceptable health risks to workers who might potentially be exposed. The current RSL for lead in soil for workers is 800 mg/kg; however the RSL assumes longer exposures than addressed in the health impact study. This area is currently covered with asphalt, which prevents direct contact of on-site workers with contaminated soil. Thus, the protectiveness of the remedy has not changed.

DRMO Yard

Yes. The exposure assumptions, toxicity data, cleanup levels, and remedial action objectives at the time the remedy was selected are still valid.

Changes in Exposure Pathways: The 2005 screening level risk assessment determined the only potentially complete and significant exposure pathway is the direct contact pathway under the commercial/industrial land use scenario. Based on a review of current land use, there have been no changes in exposure pathways.

Changes in Toxicity, Cleanup Levels, Standards to be Considered, and Risk Assessment Methodologies: No COCs or cleanup standards were identified in either the 2000 or 2006 DDs for the DRMO Yard. No cleanup ARARs were identified in either DD. A review of the risk-screening evaluation (2006 DD) shows that the risk assessment methodologies applied are still appropriate. The soil RSL for high risk PCBs addressing future residents is 0.23 mg/kg. Thus, future risks associated with the maximum detection of 0.94 mg/kg PCBs would be associated with a $4x10^{-6}$ cancer risk, which is within the “acceptable” risk range. The PCB soil RSL for workers is 0.94 mg/kg, indicating a cancer risk for workers of $1x10^{-6}$. The Toxic Substance Control Act requires a cap for soils containing more than 1 mg/kg PCBs. Thus, the screening value used for PCBs (1 mg/kg) remains protective.

IWTP

Yes. The exposure assumptions, toxicity data, cleanup levels, and remedial action objectives at the time the remedy was selected are still valid.

Changes in Exposure Pathways: The LUC remedy selected in the 2007 DD was based on an analysis in the 2007 SI Report that concluded that petroleum and metal concentrations (TPH, cPAHs, and lead) at the IWTP do not pose an unacceptable risk or hazard for any potential exposure pathways under the industrial land use scenario. While the 2007 screening level risk evaluation was not available for review, the industrial land use assumed in the 2007 screening level risk evaluation has not changed.

Changes in Toxicity, Cleanup Levels, Standards to be Considered, and Risk Assessment Methodologies: The 2007 DD states that a 2007 SI found no chemicals in the soil that posed unacceptable risks for commercial/industrial exposure. The 2007 DD placed LUCs on the area to prevent future residential use. The site is in a fenced area used for collection of excess stormwater, where even worker exposure will be minimized. In the absence of exposures, the protectiveness of the remedy is not called into question.

5.4.5.3 Question C: Battery Acid Pit, DRMO Yard, IWTP

Has any other information come to light that could call into question the protectiveness of the remedy?

No.

No new information has come to light beyond what is described in this FYR that could call into question the protectiveness of the remedy such as new or previously unidentified ecological risks or natural disaster impacts.

5.4.5.3.1 Ecological Risks

No information concerning ecological risks was discovered during the review period that could call the protectiveness of the remedy into question.

5.4.5.3.2 Natural Disasters

No natural disasters occurred that could call the protectiveness of the remedy into question.

5.4.5.3.3 Any Other Information That Could Call Into Question the Protectiveness of the Remedy

No other information came to light during the review period that could call the protectiveness of the remedy into question.

5.4.5.4 Summary of Technical Assessment: Battery Acid Pit, DRMO Yard, IWTP

The LUCs at the Battery Acid Pit, DRMO Yard, and IWTP have been inspected annually and remain protective of human health and the environment. None of the LUC inspection results have identified issues which impact the protectiveness of the remedy. The LUCs prevent residential land use (all three sites) and unplanned excavations of contaminated soils and maintenance of the asphalt cap for the Battery Acid Pit. The LUC remedy requires consideration of the nature and extent of the sites during future planning decisions and mitigation of potential impacts from the sites as necessary before any proposed residential use. Exposure assumptions made in the ROD remain valid and no changes to risk assessment, toxicity data, or cleanup levels have occurred which impact the protectiveness of the remedy.

5.5 Pesticide Rinse Area – Building 9586 (FTLE-28)

5.5.1 Background: Pesticide Rinse Area

The Pesticide Rinse Area is a 34 x 35 ft. concrete pad without secondary containment that was used for at least 24 years as a rinsing area for pesticide applicator equipment and empty chemical containers. The site is located on the south side of Building 2054.

In 1986, the USACE collected four surface soil samples that were composited and submitted for analysis of organochlorine pesticides and PCBs. One pesticide, 4,4-DDD, was detected in the composite sample at 0.005 mg/kg (USACE, 1990). The sampling results were deemed inconclusive for several reasons including soils under the slab were not sampled, subsurface soils were not sampled, and the chemical analysis was limited to organochlorine pesticides and PCBs.

Additional sampling was performed in the LFI in 1993 and 1994 to address the uncertainties noted by the USACE during the 1986 sampling. As part of the LFI, five soil borings were advanced into the underlying subsurface soils with two borings being advanced through the concrete pad. One boring was converted to a monitoring well in which groundwater was encountered at 59 feet below ground surface (bgs). The soil and groundwater samples were analyzed for chlorinated herbicides, PCBs, pesticides, and total organic carbon (TOC). Chlordane was detected at two feet beneath the concrete pad in excess of the industrial screening criteria applicable at the time (2.2 mg/kg). The soil samples indicated that only one sample exceeded the residential screening criteria for chlordane, dieldrin, and heptachlor. No contaminants were detected in the groundwater at the site. Additionally, only one sample exceeded residential USEPA Region 9 Preliminary Remediation Goals (PRGs) for chlordane, dieldrin, and heptachlor.

The current and anticipated future land use designated for the Pesticide Rinse Area in the Lewis-Main Master Plan is administration, which is equivalent to commercial (residential use is not allowed).

5.5.1.1 Site Chronology: Pesticide Rinse Area

Table 5.5-1: Chronology of Site Events at Pesticide Rinse Area

Event	Date
Investigations	1986-1994
Decision Document	2000
Implementation of LUCs	2008
Final Draft Technical Memo (formal documentation of RI/FS)	2010
Preliminary Closeout Report (documents Operational and Functional)	2015
Five-Year Reviews	2007 and 2012
Annual LUC Inspections	2011-2015

5.5.1.2 Basis for Taking Action

A screening level risk assessment was performed as part of the 2000 DD for the site. Chlordane, dieldrin, and heptachlor were present in soil in 1994 at concentrations above residential cleanup levels for the potential direct contact pathway. Fate and transport modeling of the chlordane concentration detected at two feet bgs in excess of the industrial screening level determined that it would not leach to groundwater due to a combination of adsorption and degradation. The 1993 and 1994 COPCs were compared to 1998 USEPA Region 9 PRGs in the 2000 DD and all COPCs detected were below the 1998 USEPA industrial PRGs.

5.5.2 Remedial Actions: Pesticide Rinse Area

5.5.2.1 Remedy Selection

Select soil samples reported chlordane, heptachlor, and dieldrin in excess of USEPA Region 9 residential PRGs. All samples were below the USEPA Region 9 industrial PRGs. Therefore, because

COCs at the site are above the USEPA Region 9 residential PRGs, the RAOs for the Pesticide Rinse Area is to prevent direct contact of site soils under a residential exposure scenario.

A DD dated December 2000 (Fort Lewis, 2000) included several sites including the Pesticide Rinse Area. LUCs were chosen as the selected remedy. This site is included in a Final Draft Technical Memorandum (Kemron, 2010) to formally document the selected remedies for all non-NPL CERCLA Sites that were not included in the 1990 Logistics Center ROD.

5.5.2.2 Remedy Implementation

A LUC Plan to prevent residential use was prepared by the Army and approved by EPA in 2007. The LUC's were implemented in 2008 and incorporated into the 2014 Draft LUC Plan. In a letter dated January 7, 2000, USEPA concurred that no further action would be needed after LUCs were in place to prevent residential land use for the Pesticide Rinse Area. The 2015 Preliminary Closeout Report documents operational and functional for various sites including the Pesticide Rinse Area.

5.5.2.3 Operation and Maintenance

The JBLM staff annually conducts routine monitoring and reporting of the LUCs described in the Draft 2014 JBLM LUC Plan. The routine monitoring consists of interviews with staff responsible for maintaining LUC overlays and visual field inspection of areas where LUCs apply. The JBLM LUC Monitoring Checklist is used to document the monitoring and is submitted to USEPA and Ecology for review. A copy of the 2016 LUC checklist is included in **Appendix 3.**

Site specific LUCs are in effect as documented in the 2012, 2013, 2014, and 2015 annual JBLM CERCLA LUC Checklists. The checklists documented that LUCs have successfully prevented residential land use. The site-specific LUCs have been properly maintained as evidenced by the annual inspection checklists and confirmed during the FYR site visit.

5.5.3 Progress Since Last Five-Year Review: Pesticide Rinse Area

The protectiveness statement from the 2012 FYR for the Pesticide Rinse Area states:

> *The remedies at LF 4, SRCPP, Illicit PCB Dump Site, LF 1, Battery Acid Pit, DRMO Yard, IWTP, and Pesticide Rinse Area are protective of human health and the environment. LUCs have been implemented at all these sites and have been effective in limiting exposure to site contaminants. Groundwater monitoring at LF 1 and LF 4 has demonstrated no further impact or diminishing impact by site contaminants.*

No issues or recommendations were identified in the previous FYR and no additional actions have occurred at the Pesticide Rinse Area since the previous FYR.

5.5.4 Document and Data Review: Pesticide Rinse Area

5.5.4.1 Document Review

Key installation-wide documents reviewed for this FYR can be found in **Section 3.5**. Site-specific documents reviewed include:

Fort Lewis, 2000. Decision Document for the Storm Water Outfalls/Industrial Wastewater Treatment Plant, Pesticide Rinse Area, Old Fire Fighting Training Pit, Illicit PCB Dump Site, and the Battery Acid Pit. Fort Lewis, WA. December.

Fort Lewis, 2006. Decision Document for Selected Remedy, Illicit PCB Dump Site, Fort Lewis, WA. April.

Kemron, 2010. Final Draft Technical Memorandum Fire Training Pit, Park Marsh, Pesticide Rinse Area, Illicit PCB Dump, Landfill 1, Explosive Ordnance Demolition Site 62. October.

5.5.5 Technical Assessment: Pesticide Rinse Area

5.5.5.1 Question A

Are the remedies functioning as intended by the decision documents?

Yes.

5.5.5.1.1 Remedial Action Performance

LUCs were the selected remedy for the Pesticide Rinse Area; no additional remedial actions have occurred at the site. The LUC to prevent residential land use was determined to be protective of human health and the environment in the DD. Land use at the site has not changed, and the LUCs ensure risks to human health and the environment remain within acceptable limits. The remedy is functioning as intended by the decision documents.

5.5.5.1.2 Implementation of Land Use Controls and Other Measures

The LUC to prevent residential land use is being maintained as documented through annual inspection checklists and confirmed during the FYR site visit.

5.5.5.1.3 Opportunities for Optimization

No opportunities for optimization were identified during this FYR.

5.5.5.1.4 Early Indicators of Potential Issues

No early indicators of potential issues were identified during this FYR.

5.5.5.2 Question B: Pesticide Rinse Area

Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Yes. The exposure assumptions, toxicity data, cleanup levels (DD's did not identify COCs or cleanup levels), and remedial action objective (prevent direct contact with contaminated soils) at the time the remedy was selected is still valid. Thus, no changes have occurred that call the protectiveness of the remedy into question.

Changes in Exposure Pathways: Based on the current land use, no changes in exposure pathways were identified that may result in exposure to site contaminants.

Changes in Toxicity, Cleanup Levels, Standards to be Considered, and Risk Assessment Methodologies: The 2000 DD for the Pesticide Rinse Area identified chlordane, dieldrin, and heptachlor as exceeding 1998 EPA Region 9 PRGs for residential soils, but not for industrial soils. No cleanup levels were identified in the DD; Comparison of the 1998 PRGs, the 2016 RSLs, and the MTCA Cancer Method B values in **Table 5.5-2**, below, show that the RSLs, which are the current equivalent values for EPA Region 9 PRGs, are a little higher for residents, but a little lower for workers. These differences are due to changes in exposure factors for workers relative to residents. The MTCA values represent residential exposures and are less stringent since they are somewhat higher than the residential PRGs and RSLs. Since this area is paved, effectively preventing exposures, these minor changes in the soil screening levels do not affect the protectiveness of the remedy.

Table 5.5-2. Comparison of PRGs with current RSLs and MTCA

Contaminant of Concern	1998 EPA Region 9 PRGs		2016 Regional Screening Levels		2016 MTCA Method B
	Resident mg/kg	Worker mg/kg	Resident mg/kg	Worker mg/kg	Resident mg/kg
Chlordane	1.6	12	1.7	7.7	2.86
Dieldrin	0.028	0.19	0.034	0.14	0.0625
Heptaclor	0.099	0.67	0.13	0.63	0.22

5.5.5.3 Question C

Has any other information come to light that could call into question the protectiveness of the remedy?

No.

5.5.5.3.1 Ecological Risks

No new information concerning ecological risks was found that could call into question the protectiveness of the remedy.

5.5.5.3.2 Natural Disasters

No disasters have occurred during the review period that could call into question the protectiveness of the remedy.

5.5.5.3.3 Any Other Information That Could Call Into Question the Protectiveness of the Remedy

No other information was discovered during the review period that could call the protectiveness of the remedy into question.

5.5.5.4 Summary of Technical Assessment

LUCs have been implemented and inspected annually and remain protective of human health and the environment. None of the LUC inspection results have identified issues which impact the protectiveness of the remedy. The LUCs prevent residential land use and therefore meet the RAO of preventing direct contact of soils under a residential land use setting. Exposure assumptions made in the ROD remain valid and no changes to risk assessment, toxicity data, or cleanup levels have occurred which impact the protectiveness of the remedy.

5.6 Issues: OU1 Logistics Center

No issues which effect the protectiveness of the remedy were identified for Illicit PCB Dump Site, LF-1, Battery Acid Pit, DRMO Yard, IWTP, or Pesticide Rinse Area.

Multiple issues have been identified that may affect the protectiveness of the Logistics Center remedy. Early indications of potential issues discussed in **Section 5.1.5.1.4** may also affect the future protectiveness of the Logistics Center Groundwater remedy.

Issues	Affects Protectiveness (Y/N)	
	Current	Future
1. System capture may not be complete and contaminants may be migrating beyond the LF-2 capture zone. Further information is needed to evaluate the LF-2 groundwater extraction and treatment system's capability to capture the TCE emanating from the Landfill.	N	Y
2. Groundwater extraction and treatment systems may be intercepting groundwater containing PFASs. If present reinjection may be redistributing PFASs, in some cases, in areas near the JBLM boundary.	TBD	TBD

5.7 Recommendations and Follow-up Actions: OU1 Logistics Center

Recommendations / Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
				Current	Future
1. Evaluate if the system is providing complete capture of the plume in accordance with the RAOs through monitoring and capture zone analysis. The evaluation strategy could include installation of additional wells downgradient of the wells of concern, capture zone analysis,	U.S. Army	USEPA	2022	N	Y

and rehabilitation or replacement of PW-1. 2. Evaluate presence of PFASs at the Logistics Center through collection of water samples at Landfill 2 and the influent and effluent at three pump and treat systems (LF-2, I-5, and SLA).	U.S. Army	USEPA	2020	TBD	TBD

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5.7.1 Other Recommendations

Recommendations / Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
				Current	Future
1. Consider more frequent monitoring of LC-226 downgradient of the I-5 system to study if the I-5 system is providing complete capture of the plume. Quarterly monitoring of monitoring well LC-226 should be considered for 1-2 years to further evaluate concentration trends.	U.S. Army	USEPA	2018	N	N
2. Ensure that extraction rates from existing production wells near the Logistics Center groundwater plume are considered in future modeling and capture zone analyses. Specifically, determine whether the MAMC series wells are adversely affecting SLA system capture.	U.S. Army	USEPA	NA	N	N
3. Recommend annual sampling of monitoring well LC-80D to monitor groundwater concentrations in the SLA west/northwest of the plume.	U.S. Army	USEPA	NA	N	N

5.8 Protectiveness Statement: OU1 Logistics Center

A protectiveness determination for the OU1 – Logistics Center Remedy cannot be made at this time until further information is obtained. Further information will be obtained by taking the following action: an investigation and evaluation of the presence of PFASs within the three pump and treat systems at the Logistics Center. It is expected that this action will take approximately three years to complete, at which time a protectiveness determination will be made.

The following elements of the remedy have ensured that RAOs are being met. LUCs prevent exposure to groundwater by restricting installation of new drinking water wells within the areal extent of the TCE groundwater plume inside the JBLM boundary. Existing LUCs are preventing exposure to soil by maintaining a fence with signs around the perimeter of LF-2 and restricting training activities and unauthorized digging and construction within LF-2. LUCs are preventing exposure by preventing residential land use at LF-2 or within the 100 ug/L groundwater isoconcentration contour. The I-5 and SLA P&T systems prevent migration of contaminated groundwater within the Upper Vashon, Lower Vashon, and SLA.

Additionally, in order for the remedy to be protective in the long-term, the following action needs to be taken to ensure protectiveness: a thorough evaluation of whether the LF-2 system is providing complete capture of the plume in accordance with the RAOs through monitoring and capture zone analysis. If capture zone analysis shows lack of capture, pumping should be increased (through additional extraction well(s) and/or increased pumping).

At the Illicit PCB Dump Site, LUCs prevent exposure to contaminated soils by maintaining a fence with signs warning against unauthorized excavation and digging, restricting access, and ensuring the site is not used for training or residential land use. Maintenance of the cap also restricts exposure to contaminated soils.

At Landfill 1, LUCs are preventing exposure to groundwater and landfill wastes by restricting residential development, unplanned excavation, and installation of new drinking water wells within a 1,000 feet of the site boundary.

At the Battery Acid Pit, DRMO Yard, IWTP, and Pesticide Rinse Area, LUCs are preventing exposure to contaminated soils through maintenance of the asphalt cap and excavation and construction restrictions at the Battery Acid Pit and through prevention of residential land use at the Battery Acid Pit, DRMO Yard, IWTP, and the Pesticide Rinse Area.

6.0 Operable Unit 2 - Landfill 4 and Solvent Refined Coal Pilot Plant

Operable Unit 2 (OU2) is comprised of the following sites:

- Landfill 4 (NPL) – FTLE-57
- Solvent Refined Coal Pilot Plant (SRCPP) (NPL) – FTLE-32

Because these two sites have different response actions, this section is structured to discuss the history, response action, data review, and technical assessment for each site (Section 6.1 through 6.2). A combined set of issues, recommendations, and one protectiveness statement are included in Sections 6.3, 6.4, and 6.5, respectively.

6.1 Landfill 4 (FTLE-57)

6.1.1 Background: Landfill 4 (FTLE-57)

Landfill 4 (LF 4) is approximately 52-acres consisting of three “cells” (Northwest, Northeast, and South) and was reportedly used for disposal of solid waste between 1951 and 1967. The site is located on Lewis-North (former North Fort Lewis), approximately 500 feet north of Sequalitchew Lake (**Figure 6-1**). Although there are no records, the waste materials probably consisted of domestic and light industrial solid waste (including domestic liquids and biosolids collected by septic tank pump trucks) and construction debris.

The landfill, located within the operational range area, is currently used for military training activities. Anticipated future land use for LF 4 is restricted training within Training Area 2 of the Lewis-Main operational range area.

6.1.1.1 Site Chronology: LF 4

Table 6-1: Chronology of Site Events at LF 4

Event	Date
Site Investigation – Monitoring Well Installation	1981
Site Investigation	1990
Remedial Investigation / Feasibility Study	1993
Record of Decision signed	1993
Remedy Implementation	1994
Remedial Action Operation: Air Sparge / Soil Vapor Extraction System Operation	1996-1999
Groundwater Monitoring and LUC Inspections	1994 - present
Preliminary Closeout Report (documents Operational and Functional)	2015
Five-Year Reviews	2002, 2007, 2012

6.1.1.2 Basis for Taking Action

Remedial action was required at LF4 due to presence of TCE and VC and to protect human health and the environment under potential future land use conditions. Action was required because upper aquifer groundwater beneath the site is contaminated with TCE and VC at levels exceeding State and Federal MCLs, and the excess cancer risk associated with a reasonable maximum groundwater exposure for potential future residential populations exceeds both Federal and State allowable risk thresholds. Potential impacts to nearby surface water bodies were a concern because the highest TCE concentration was detected in a monitoring well located between LF4 and Sequalitchew Springs which serves as a drinking water supply for JBLM.

6.1.2 Remedial Actions: Landfill 4 (FTLE-57)

6.1.2.1 Remedy Selection

RAOs include:

- Prevent exposure to contaminated groundwater.
- Restore contaminated groundwater to its beneficial use, which is drinking water.
- Minimize movement of contaminants from soil to groundwater.
- Prevent exposure to landfill contents.

The selected remedy specified in 1993 ROD, includes treatment of suspected sources of groundwater contamination, treatment of contaminated groundwater, groundwater monitoring, and implementation of institutional controls to protect human health and the environment during remedial action. The 1993 ROD includes both LF 4 and SRCPP, and, as indicated on the ROD's title page, represents OU2 of the Fort Lewis Logistics Center. Major components of the LF 4 selected remedy include:

- Installing an active soil vapor extraction system (SVE) in suspected groundwater contamination source areas. Vapors from the system will be treated in compliance with air quality regulations prior to discharge.

- Installing an in situ groundwater sparging system to remove volatile contaminants from groundwater. The sparging system will work in conjunction with the SVE system.

- Monitoring upper aquifer groundwater to determine the effectiveness of the selected remedy. As part of the monitoring program, the localized area of elevated manganese on the western borders of the South and Northwest LF 4 will be monitored to determine any changes in manganese concentrations. If the monitoring indicates that manganese concentrations are not declining, the need for remediation of the localized areas will then be reevaluated. This reevaluation may include supplemental sampling, or additional source characterization.

- Maintaining institutional controls restricting access to and development at the site as long as hazardous substances remain onsite at levels that preclude unrestricted use.

Upper aquifer groundwater cleanup levels have been established to meet regulatory requirements. MTCA Method B was used to determine the cleanup level for VC at 1 µg/l which was the PQL for VC at the time the ROD was signed. The Federal MCL was used to determine the cleanup level for TCE at 5 µg/l.

In order to address the potential future drinking water pathway, a land use control on groundwater use planning within 1000 feet of the site boundary was included.

6.1.2.2 Remedy Implementation

The air sparging/soil vapor extraction system component of the remedy was completed as documented in the 2001 LF-4 Air Sparging/Soil Vapor Extraction Remediation Report. It included four air sparge wells, six vapor extraction wells, four passive injection wells, and three Upper Vashon monitoring wells. The system operated from 1996 to 1999. Groundwater monitoring is being implemented in accordance with the 2004 Groundwater Monitoring Plan for LF-4, which has since undergone updates. The land use control portion of the remedy was formally implemented in a 2007 Land Use Control Plan.

6.1.2.3 Operation and Maintenance

Based on a review of the annual monitoring reports from 2012 to 2016, groundwater monitoring has been conducted in accordance with the 2007 Groundwater Monitoring Plan for LF-4. The Groundwater Monitoring Plan is being updated to optimize the well network and sample frequency based on discussions during the September 8, 2016 FFA meeting. The monitoring well network is predominantly in the Upper Vashon but includes a few wells constructed in the Lower Vashon (**Figure 6-1**). In 2016, samples were collected from approximately 20 monitoring locations, including Sequalitchew Spring (water supply well) and analyzed for TCE, VC, and DCE; select locations were analyzed for manganese. Statistical analyses were performed to determine trends within the last 10 years and progress towards RAOs.

Site specific LUCs are in effect as documented in the 2012, 2013, 2014, and 2015 annual JBLM CERCLA LUC Checklists. The checklists document whether LUCs are effectively preventing residential land use, unplanned excavations, and bivouacking or off-road vehicle maneuvering within the boundary of the landfill as well as installation of new drinking water wells within 1,000 feet of the landfill boundary. During the site visit, ruts and indications of off-road maneuvering were present at the South landfill. With the exception of this observation, the LUCs appeared to be maintained.

During the FYR site inspection conducted, it was noted that various monitoring wells were unlocked and that the AS/SVE wells remain in place.

6.1.3 Progress Since Last Five-Year Review: Landfill 4

The protectiveness statement from the 2012 installation-wide FYR stated:

> *The remedies at LF 4, SRCPP, Illicit PCB Dump Site, LF 1, Battery Acid Pit, DRMO Yard, IWTP, and Pesticide Rinse Area are protective of human health and the environment. LUCs have been implemented at all these sites and have been effective in limiting exposure to site contaminants. Groundwater monitoring at LF 1 and LF 4 has demonstrated no further impact or diminishing impact by site contaminants.*

No issues or recommendations were identified in the previous FYR report. No additional actions have occurred at LF-4 since the previous FYR.

6.1.4 Document and Data Review: Landfill 4

6.1.4.1 Document Review

Key installation-wide documents reviewed for this FYR can be found in **Section 3.5**. Site-specific documents reviewed include:

Applied Geotechnology Inc., 1993. Final Feasibility Study Report, Landfill 4 and Solvent Refined Coal Pilot Plant. May.

Sealaska Environmental (SES), 2015. 2014 Annual Groundwater Monitoring Report, Landfill 4. August.

Sealaska Environmental (SES), 2016. 2016 Regulator Draft Annual Groundwater Monitoring Report, Landfill 4. November.

Versar, 2013. 2013 Annual Groundwater Monitoring Report, Landfill 4. October.

Versar, 2012. 2012 Annual Groundwater Monitoring Report, Landfill 4. December.

USEPA, 2015. Preliminary Close Out Report, Logistics Center. September.

USEPA, 1993. Record of Decision for Landfill 4 and the Solvent Refined Coal Pilot Plant. Fort Lewis Military Reservation, WA. September.

6.1.4.2 Data Review and Evaluation

Localized groundwater flow in the vicinity of LF-4 is to the west and southwest towards Sequalitchew Lake and is influenced by pumping from Sequalitchew Springs (**Figure 6-1**). Out of the approximately 20 locations sampled in 2016, only one well exceeded site cleanup levels: 7.8 µg/L of TCE was present at MW-DG1. The 2016 annual report calculated a not statistically significant downward trend from 2007 to 2016. Time series data for select monitoring wells are presented on **Figure 6-2**. Manganese (Mn) has also been monitored per the ROD and concentrations have been below the target of 2,200 µg/L for two consecutive years (2015 and 2016). The maximum concentration of Mn in 2016 was 1,490 µg/L. Results from annual sampling of Sequalitchew Springs beginning in 1992 have been non-detect for VOCs with only one detection of manganese at 15 µg/L in 1994.

6.1.5 Technical Assessment: Landfill 4

6.1.5.1 Question A

Is the remedy functioning as intended by the decision documents?

Yes.

6.1.5.1.1 Remedial Action Performance

Groundwater monitoring program has been implemented and is periodically updated. As of 2016, TCE is present above the RG at only one of the 20 wells sampled. Time series charts indicate TCE concentrations are decreasing in wells with the highest historical concentrations. Monitoring of Sequalitchew Springs, one of JBLM's primary water supply locations shows VOCs have been non-detect since 1992.

6.1.5.1.2 Operations and Maintenance

Groundwater monitoring has been conducted in accordance with the 2007 Groundwater Monitoring Plan and an updated plan was being prepared as of 2016.

6.1.5.1.3 Opportunities for Optimization

Further optimization of the monitoring network is merited given low levels of COCs present (predominately below the RGs) and extended monitoring record (over 20 years) which includes over ten years following shutdown of the AS/SVE system.

6.1.5.1.4 Implementation of Land Use Controls and Other Measures

The JBLM staff conducts annual monitoring and reporting of the LUCs described in the Draft 2016 JBLM LUC Plan. Site specific LUCs are in effect and are generally properly maintained as documented in the 2012, 2013, 2014, and 2015 annual JBLM CERCLA LUC Checklists. LUCs consist of preventing residential land use, unplanned excavations, and bivouacking or off-road vehicle maneuvering within the boundaries of the landfill and installation of new drinking water wells within 1,000 feet of the landfill boundary. During the site visit, ruts were observed on the south landfill indicating further enforcement of this LUC is needed to prevent potential exposure. The ruts did not appear to penetrate more than six inches into the cover which ranges from 0.5 to 4 ft in thickness according to the 1993 Feasibility Study (USACE, 1993). Therefore, LUCs are still meeting the RAO of preventing exposure to landfill contents.

6.1.5.1.5 Early Indicators of Potential Issues

Increased enforcement is needed to prevent activities that erode into the landfill cover or generate ruts.

6.1.5.1.6 Question B

Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Yes. There have been changes to risk assessment methods, exposure assumptions, and toxicity factors, but these do not call the protectiveness of the remedy into question. ARARs have not changed since the original risk assessment (**Table 3-1**). Comparison of cleanup levels to current Regional Screening Levels (RSLs) indicate that risks fall within acceptable ranges. The RAOs for preventing exposure of human and ecological receptors to contaminated soil and groundwater are valid. Overall, no changes have occurred that call the protectiveness of the remedy into question.

Changes in Risk Assessment Methods and Exposure Assumptions

A number of changes in risk assessment methods and exposure assumptions have taken place since the 1993 Risk Assessment. These changes are summarized in **Appendix 5**. These changes have not been significant enough to call the protectiveness of the remedy into question.

The potential for VI was assessed for all FYR sites with VOCs. The three monitoring wells with TCE concentrations above the MCL over the last five years were MW-DG1 (13 µg/L), MW-UG1 (9.2 µg/L), and LF4-1 (6.5 µg/L). These wells are 1,500 feet from the nearest building (**Figure 6-1**), within the LF-4 site boundary, and subject to LUCs that prevent residential development and unpermitted excavations. The USEPA Vapor Intrusion Screening Level (VISL) calculator estimated that under a commercial land use scenario, a groundwater concentration of 13 µg/L TCE resulted in a cancer risk level of $1x10^{-6}$ and a non-cancer hazard quotient of 0.3, both considered within acceptable risk ranges. Well LF4-PNL4 contains the highest concentration of VOCs in groundwater within 100 feet of a building and outside the LF-4 site boundary. While the Master Plan identifies this area's land use as administration and maintenance, land use was assumed to be residential in absence of land use restrictions. The highest concentration of VOCs observed in this well over the last five years were input into USEPA VISL calculator. Under a residential land use scenario, the cancer risk was $3x10^{-6}$ and the non-cancer hazard quotient was 0.4, both considered within acceptable risk ranges. Therefore, the potential for VI does not affect the remedy's current or future protectiveness.

Changes in Toxicity Values

Changes in toxicity values for chemicals evaluated in the LF-4 risk assessment are presented in **Appendix 5**. The effects of these changes are not sufficient to call the protectiveness of the remedy into question.

Changes in ARARs and TBCs

In the 1993 ROD, the primary MCL for TCE was set as a RG in groundwater. The RG for vinyl chloride is identified as the PQL of 1 µg/L, although MTCA Method B is cited. The current MTCA Method B standard for vinyl chloride in groundwater is 0.029 µg/L, associated with a 10^{-6} cancer risk. These values are shown in **Table 3-1**. The cancer risk associated with the 1 µg/L PQL used as the RG for vinyl chloride in groundwater is $3x10^{-5}$, well within the "acceptable" risk range of 10^{-6} to 10^{-4}. Therefore, changes to the ARAR values do not call the protectiveness of the remedy into question.

The evaluation of whether changes in risk assessment methods, exposure assumptions, and toxicity values, as presented in previous sections, can call the protectiveness of the remedy into question is perhaps best made by using the RSL calculator to determine the risks associated with the RGs that would be determined using current equations, exposure factors, and toxicity values. **Table 3-1** shows the results of this determination. In **Table 3-1**, the cancer risks for TCE and vinyl chloride, even if totaled together, are substantially less than 10^{-4}. These cancer risks are calculated for a combined adult-child exposure lasting 30 years and incorporating exposure by ingestion, dermal contact, and inhalation of vapors generated by indoor water use, but not VI.

Changes in RAOs

The RAOs remain valid as they prevent human and ecological receptors from exposure to groundwater contaminants. By eliminating unacceptable risks, the RAOs ensure the remedy remains protective of human health and the environment until the contaminated groundwater is restored to its designated use.

6.1.5.2 Question C

Has any other information come to light that could call into question the protectiveness of the remedy?

No.

6.1.5.2.1 Ecological Risks

No additional information has come to light that would affect the protectiveness of the remedy with respect to ecological receptors.

6.1.5.2.2 Natural Disasters

No natural disasters have occurred that could call the protectiveness of the remedy into question.

6.1.5.2.3 Any Other Information That Could Call Into Question the Protectiveness of the Remedy

No other information was discovered during the review period that could call the protectiveness of the remedy into question.

6.1.5.3 Summary of Technical Assessment

Groundwater monitoring has been conducted in accordance with the ROD and the Groundwater Monitoring Plan. As of 2016, TCE is the only COC present above the RG and at only one of the approximately 20 monitoring wells. Time series charts and statistical analyses show decreasing concentrations in wells with the highest levels of COCs recorded historically. Further optimization of the monitoring program is recommended. LUCs have been implemented and inspected annually and remain protective of human health and the environment. The LUC inspection results have not identified issues which impact the protectiveness of the remedy; however the observation of ruts on the South Landfill during the site visit indicates additional enforcement is needed. The LUCs are effectively preventing residential land use, unplanned excavation, off-road maneuvering within the boundaries of the landfills and installation of drinking water wells within 1,000 feet of the landfill boundary. Exposure assumptions made in the ROD remain valid and no changes to risk assessment, toxicity data, or cleanup levels have occurred which impact the protectiveness of the remedy.

6.2 SRCPP (FTLE-32)

6.2.1 Background: SRCPP

The approximately 25-acre Solvent Refined Coal Pilot Plant (SRCPP) operated from 1974 to 1981 as a production and research facility designed to develop a solvent extraction technology for deriving petroleum hydrocarbon-like products from coal (**Figure 4-1**). In 1979, there was a 2,000-gallon spill of solvent refined coal liquid fuel. Subsequent investigations of both soil and groundwater indicated other sources of soil and groundwater contamination might exist at the SRCPP.

Potential impacts to nearby surface water bodies and groundwater were assessed. Part of the site was paved and the concern was that removal of the pavement could mobilize vadose zone contaminants. Available records are limited, but indicate a large volume of contaminated soil was excavated and removed from the spill area in late 1980. Additional actions that were taken include sludge excavation in the wastewater lagoon in 1982, soil sampling from an overflow channel, and a groundwater monitoring plan that was used as part of the facility decommissioning.

6.2.1.1 Site Chronology: SRCPP

Table 6-2: Chronology of Site Events at SRCPP

Event	Date
Spill of solvent refined coal liquid fuel	1979
Initial Response (soil excavation and sludge excavation from lagoon)	1980-1982
Remedial Investigation / Feasibility Study	1993
Record of Decision	1993
Remedy Implementation – Low temperature thermal desorption	1996-1997
Remedy Implementation – Groundwater and surface water monitoring	1981-1999
Preliminary Closeout Report (documents Operational and Functional)	2015
Five-Year Reviews	2002, 2007, 2012
Annual LUC Inspections	2011-2015

6.2.1.2 Initial Response

Available records are limited, but indicate a large volume of contaminated soil was excavated and removed from the spill area in late 1980. Sludge excavation was conducted in the wastewater lagoon in 1982.

6.2.1.3 Basis for Taking Action

Remedial action was required because soils beneath the site were contaminated with carcinogenic polycyclic aromatic hydrocarbons (PAHs) at levels exceeding State regulatory requirements; carcinogenic PAHs in soil have the potential, if site pavements are removed, to adversely impact groundwater. Predictive modeling indicates risks from impacted groundwater could exceed MTCA risk goals.

6.2.2 Remedial Actions: SRCPP

6.2.2.1 Remedy Selection

The selected remedy from the 1993 ROD (USEPA, 1993) included soil excavation and on-site treatment, groundwater monitoring, and LUCs. The 1993 ROD includes both LF 4 and SRCPP, and, as indicated on the ROD's title page, represents OU2 of the Fort Lewis Logistics Center.

RAOs are to:

- Prevent exposure to contaminated soils,
- Prevent movement of contaminants from soil to groundwater, and
- Prevent exposure to contaminated upper aquifer groundwater beneath the former SRCPP.

The major components of the selected remedy include:

- Excavation and treating contaminated soils. Soils will be treated using either soil washing to thermal destruction to meet cleanup levels.

- Monitoring upper aquifer groundwater beneath and adjacent to the site to determine the effectiveness of soil treatment.
- Maintaining institutional controls restricting access to and development at the site as long as hazardous substances remain onsite at levels that preclude unrestricted use.

Soil cleanup levels were established to meet State ARARs which will result in a cumulative risk not to exceed 1 x 10^{-5}. MTCA Method B was used to determine the cleanup level for total carcinogenic PAHs at 1.0 milligrams per kilogram (mg/kg). Groundwater cleanup standards were set at 0.1 µg/L for PAHs and 80 µg/L for manganese.

6.2.2.2 Remedy Implementation

Following completion of the soil cleanup via low temperature desorption, groundwater monitoring was performed for two years. Sampling was conducted in five downgradient monitoring wells. No site related contamination was detected at the point of compliance. Based upon a September 28, 1999 Memorandum by the EPA Superfund Project Manager, groundwater monitoring activities were curtailed. The LUCs were implemented in 2008 under the Fort Lewis LUC Plan.

6.2.2.3 Operation and Maintenance

Maintenance of LUCs is the only active component of the SRCPP remedy. The LUC objective for SRCPP documented in the Draft 2016 JBLM LUC Plan is to prevent new drinking water wells without EPA approved monitoring plan. Under the current non-residential land use scenario there are no complete exposure pathways and there are no current drinking water receptors.

The JBLM staff annually conducts routine monitoring and reporting of the LUCs described in the 2016 JBLM LUC Plan. The routine monitoring consists of interviews with staff responsible for maintaining LUC overlays and visual field inspection of areas where LUCs apply. The JBLM LUC Monitoring Checklist is used to document the monitoring and is submitted to USEPA and Ecology for review. A copy of the most recent LUC checklist is included in **Appendix 3.**

The annual JBLM CERCLA LUC Checklists reviewed for this report (2011 through 2015) did not include the SRCPP specifically; however they did verify that there were no new drinking water wells within any of the LUC boundaries. Based on the review of the Draft 2016 JBLM LUC Plan, there was no SRCPP-specific LUC objective to restrict access to and development at the site. Additionally, the 2015 Preliminary Closeout Report states that institutional controls are required to prevent residential development.

No other specific SRCPP issues were identified in the checklists. Based on the site visit conducted for this FYR, the current SRCPP land use remains industrial.

6.2.3 Progress Since Last Five-Year Review: SRCPP

The protectiveness statement from the 2012 installation-wide FYR stated:

> *The remedies at LF 4, SRCPP, Illicit PCB Dump Site, LF 1, Battery Acid Pit, DRMO Yard, IWTP, and Pesticide Rinse Area are protective of human health and the*

> *environment. LUCs have been implemented at all these sites and have been effective in limiting exposure to site contaminants. Groundwater monitoring at LF 1 and LF 4 has demonstrated no further impact or diminishing impact by site contaminants.*

No issues or recommendations were identified in the previous FYR report. No additional actions have occurred at the SRCPP since the previous FYR.

6.2.4 Document and Data Review: SRCPP

6.2.4.1 Document Review

Key installation-wide documents reviewed for this FYR can be found in **Section 3.5**. Site-specific documents reviewed include:

USEPA, 1993. Record of Decision for Landfill 4 and the Solvent Refined Coal Pilot Plant. Fort Lewis Military Reservation, WA. September.

6.2.4.2 Data Review and Evaluation

It was noted that the Draft 2016 JBLM LUC Plan (Table, Figure, and Annual Checklist) did not include prevention of residential land use within the boundary of SRCPP.

6.2.5 Technical Assessment: SRCPP

6.2.5.1 Question A

Is the remedy functioning as intended by the decision documents?

Yes.

6.2.5.1.1 Remedial Action Performance

Remedial actions including excavation with low temperature thermal desorption and groundwater monitoring have been completed and/or discontinued. The LUCs are ongoing and restrict installation of new drinking water wells.

6.2.5.1.2 Operations and Maintenance

LUCs are the only active component of the SRCPP remedy.

6.2.5.1.3 Opportunities for Optimization

No opportunities for optimization were identified during this FYR.

6.2.5.1.4 Implementation of Land Use Controls and Other Measures

The LUCs are properly maintained with the exception of incorporating prevention of residential land use development into the Draft 2016 JBLM LUC Plan and annual inspection checklists. The annual LUC inspections have successfully documented new drinking water wells have not been installed. The site visit confirmed no residential development has occurred.

6.2.5.1.5 Early Indicators of Potential Issues

No early indicators of potential issues were identified during this FYR.

6.2.5.2 Question B

Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Yes. The exposure assumptions, toxicity data, cleanup levels, and remedial action objectives at the time the remedy was selected are still valid.

Changes in Exposure Pathways: The only remaining component of the site remedy at SRCPP is the maintenance of LUCs. A review of the HHRA was not performed; however land use has not changed, drinking water well installation is restricted, the remedy is in place, and physical conditions have not changed since remedial construction was complete. Therefore, exposure pathways are presumed to be unchanged.

Changes in Toxicity, Cleanup Levels, Standards to be Considered, and Risk Assessment Methodologies: In order to evaluate whether a change in standards, risk assessment methodologies, or contaminant toxicity affects the remedy's protectiveness, RGs were compared to updated ARARs and USEPA Regional Screening Levels as summarized in **Table 3-1**. The 1993 ROD set RGs for soil and groundwater based on MTCA values. A collective cPAH MTCA Model B level of 1 mg/kg was set for benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene, based on a total cancer risk of 10^{-6}. Because this cleanup goal covers any combination of the seven cPAHs up to a total 1 mg/kg, the current MTCA level cited is for benzo(a)pyrene, which is the basis for comparison of cancer potency of PAHs. Comparison of the past and current values indicates that soils with up to 1 mg/kg cPAHs could pose a cancer risk of up to 7×10^{-6}, which is near the lower end of the acceptable risk range of 10^{-6} to 10^{-4}. A similar selection was made in establishing 0.1 µg/L cPAHs as the groundwater cleanup goal. This value was set using MTCA Method C based on a 10^{-5} cancer risk level. The current MTCA Model C level is 0.12 µg/L for the cPAHs, indicating the original MTCA now corresponds to an 8×10^{-6} cancer risk level, also well within the acceptable risk range for cancer risks. The current MTCA level for manganese in groundwater is 2,240 µg/L, indicating that the potential for adverse non-cancer health effects has significantly decreased compared to the original RG of 80 µg/L. In summary, there have been no changes in toxicity or contaminant characteristics that affect the protectiveness of the remedy.

6.2.5.3 Question C

Has any other information come to light that could call into question the protectiveness of the remedy?

No.

6.2.5.3.1 Ecological Risks

No new information concerning ecological risks has been found that could call the protectiveness of the remedy into question.

6.2.5.3.2 Natural Disasters

No natural disasters have occurred that could call the protectiveness of the remedy into question.

6.2.5.4 Any Other Information That Could Call Into Question the Protectiveness of the Remedy

No other information has come to light that could call into question the protectiveness of the remedy.

6.2.5.5 Summary of Technical Assessment

Excavation has been completed and groundwater monitoring has been discontinued in accordance with the ROD and post-ROD documentation. LUCs have been implemented and inspected annually. An additional LUC to restrict residential land use is necessary to ensure future protectiveness. None of the LUC inspection results have identified issues which impact the current protectiveness of the remedy. The LUCs have prevented installation of new drinking water wells. Exposure assumptions made in the ROD remain valid and no changes to risk assessment, toxicity data, or cleanup levels have occurred which impact the protectiveness of the remedy.

6.3 Issues: OU2 Landfill 4 and SRCPP

No issues have been identified that affect the current protectiveness for LF4 or SRCPP; however residential land use restrictions for SRCPP need to be incorporated into the JBLM LUC Plan to ensure future protectiveness.

Issues	Affects Protectiveness (Y/N)	
	Current	Future
1. Residual soil contamination does not allow residential land use at SRCPP. The Final 2017 LUC Plan does not restrict residential land use at SRCPP.	N	Y

6.4 Recommendations and Follow-up Actions: OU2 Landfill 4 and SRCPP

Recommendations / Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
				Current	Future
1. Incorporate prevention of residential land use for SRCPP into the JBLM LUC Plan and annual inspection checklists.	U.S. Army	USEPA	2019	N	Y

6.4.1 Other Recommendations

Recommendations that do not affect the protectiveness of the remedy but will improve overall housekeeping at LF-4 and SRCPP include the following observations from the September 2016 site visit:

Recommendations / Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
				Current	Future
Landfill 4					
1. The AS/SVE system operated from 1996 through 1999. These wells remain in place with no apparent intent to resume operation. Consider abandoning these wells or including in the Well Decommissioning Work Plan discussed during the September 2016 FFA meeting. 2. Various monitoring wells were not locked as shown in a picture included in **Appendix 3.** Ensure that all monitoring or former remediation wells are locked 3. Improve enforcement of LUC preventing off-road maneuvering. 4. During the site visit, one of the monitoring wells appeared to be damaged by a tree (picture included in **Appendix 3**). Ensure well is appropriately abandoned or if part of LTM program, replaced.	U.S. Army	USEPA	NA	N	N
SRCPP					
5. Two to three well houses were observed within the tree-covered area along the western edge of the SRCPP boundary. These wells are not operational or part of the SRCPP remedy. Confirm that	U.S. Army	USEPA	NA	N	N

these wells have been properly abandoned, the electrical lines disconnected, and whether the well houses should be removed. 6. A well appeared to have been hit by a fallen tree and should be abandoned. 7. Four vessels with used Granular Activated Carbon (GAC) were observed on the SRCPP along the southern site boundary (see picture in **Appendix 3**). Recommend characterization and proper disposal of vessels with GAC.					

6.5 Protectiveness Statement: OU2 Landfill 4 and SRCPP

The remedy at OU2 – LF-4 and SRCPP is currently protective of human health and the environment because:

- At LF-4, LUCs prevent exposure to contaminated groundwater by preventing installation of new drinking water wells within 1,000 ft of the site boundary. LUCs prevent exposure to landfill contents and contaminated soil by preventing residential land use, unplanned excavations, and off-road maneuvering within the site boundary.

- At SRCPP, LUCs prevent exposure to contaminated groundwater by restricting installation of new drinking water wells within the site boundary without an EPA approved monitoring plan. The site's non-residential land use has prevented exposure to contaminated soils.

However, in order for the remedy to be protective in the long-term, the prevention of residential land use at SRCPP needs to be incorporated into the Final JBLM LUC Plan and annual inspection checklists to ensure protectiveness.

7.0 Operable Unit 3 - American Lake Garden Tract (MF-ALGT-LF-05)

7.1 Background: Area D/ALGT

Area D/ALGT is located approximately 7 miles south of downtown Tacoma in central Pierce County, Washington. Geographical features that roughly bound the site include Interstate 5 to the northwest, Porter Hills and McChord AFB ammunition storage area to the north, Burlington Northern Railroad and “A” Street to the east, Wescott Hills and Fort Lewis Logistic Center to the south, and ALGT to the southwest (**Figure 7-1**). Area D lies in the southwestern portion of McChord Field, where several disposal areas were operated at various times from the mid-1940s to the early 1970s. The Whispering Firs Golf Course (and driving range) now overlies several of the former Area D disposal areas. McChord Field also contains a large residential area in the southwestern portion of Area D. Immediately southwest of Area D lies the off-base residential housing of the ALGT. Based on the February 23, 2000, “Deferral Agreement" between EPA and Ecology, McChord Field was assigned to Ecology for lead oversight and management under the 1990 Federal Facility Agreement.

Seven former subsites within Area D subsequently were included in the NPL listing of the Area D/ALGT site for investigation and potential cleanup: Landfill 4, Landfill 5 (LF-5), Landfill 6, Landfill 7, Ordnance Disposal Area 26, Radioactive Disposal Well 35, and Old Burn Trench 39 (OT-39) (**Figure 4-2**).

LF-5 is the source area of groundwater impacts and adjoins OT-39. The other six subsites that comprise the Area D/ALGT NPL site were determined to pose no unacceptable risk to human health or the environment; however, LUCs are still required at Landfill 4, Landfill 6, Landfill 7, and OT-039 (Environmental Management Branch, 1991).

Landfill 5 operated as a landfill between 1951 and the mid-1960s. The landfill was used for disposal of industrial, domestic, and construction waste, including waste oil, fuel, and possibly spent solvents. Currently, LF-5 is the driving range of the Whispering Firs golf course. Site OT-39 was an open trench used for disposal of waste petroleum, oils, and liquids (POL), solvents, and fuel from 1953 to the early 1960s. Currently, OT-39 is Fairway 10 of the Whispering Firs golf course.

7.1.1 Former ALGT Subsites

The following summarizes additional background and post closure monitoring associated with the six ALGT subsites that the 1991 ROD determined would not pose an unacceptable risk to human health and/or the environment. JBLM environmental restoration managers indicated a report is being drafted in 2017 to formally document closure of the subsites listed below.

- **Site LF-004**, in operation between 1941 and 1978, was a gravel pit that had been converted to a landfill. Waste disposal activities in this area between 1941 and 1958 are unknown. Between 1958 and 1978, disposal included rubbish, garbage, and industrial waste. No contamination above regulatory limits was found during the RI and subsequent long-term monitoring events. Two additional groundwater samples were collected at Site LF-004 in 1995 under the LTM program. No contaminants were reported above regulatory limits. The current land use of Site LF-004 is a soccer field.

- **Site LF-006**, in operation from the early 1960s until closure in March 2000 by the Tacoma-Pierce County Health Department, was a borrow pit that had been converted to a demolition debris landfill. At the time of closure, the landfill was graded and capped. The Health Department continued to perform periodic inspections after the closure until 2007. No contamination above regulatory limits was found during the RI and subsequent long-term monitoring events. No further action is required by the Health Department. The current land use of Site LF-006 is undeveloped land.

- **Site LF-007**, in operation between 1967 and 1972, was a pond converted to a landfill. The landfill was used for disposal of industrial, domestic, and construction waste. One groundwater sample was reported to contain trichloroethene (TCE) at a concentration of 5.5 µg/L; however, the average concentration over five sampling events was 1.91 µg/L, below the EPA's MCL of 5 µg/L. No contamination above regulatory limits was found during subsequent long-term monitoring events. The current land use of Site LF-007 is Fairway 17 of the Whispering Firs golf course.

- **Site OT-026** includes Whitman Lake, Baxter Lake, the Whispering Firs golf course duck pond, and undeveloped adjacent areas. The site was used for ordnance disposal (e.g., grenades and fragmentation bombs) between 1943 and 1956, and consisted of stumps and grass during the 1960s and 1970s. No contamination above regulatory limits was found during the RI and subsequent long-term monitoring (LTM) events. No evidence of munitions and explosives of concern or munitions debris was found during a Comprehensive Site Evaluation completed in 2010. The current land use of Site OT-026 is undeveloped wetlands and/or golf course water hazards.

- **Site RW-035** was originally thought to be a dry well used for disposal of low-level radioactive waste (LLRW) during the 1950s. A closed-bottom concrete vault was excavated during 2003, and one lined steel drum of material and concrete was disposed of at the U.S. Ecology facility at the Hanford Nuclear Reservation in Washington. The excavation was backfilled using clean overburden, and a closure report was prepared. No contaminants were reported to be present above the regulatory limits. The current land use is an undeveloped wooded area behind the Whispering Firs golf course maintenance shop.

- **Site OT-039**, in operation from 1953 to the early 1960s, was an open trench. The trench was reportedly used for disposal of waste petroleum, oils, and liquids, as well as solvents and fuel. The site is upgradient of LF-005, where a dissolved plume consisting mainly of TCE and dichloroethene was identified during the RI, and underwent remediation (volume reduction and containment) between 1994 and 2016. Resource protection wells downgradient of Site OT-039 included in the monitored natural attenuation program were sampled beginning in 2016. No contaminants have been reported to be present above regulatory limits. The current land use is Fairway 10 of the Whispering Firs golf course.

7.1.2 Land and Resource Use

A base golf course and driving range now overlie former landfills that were part of the Area D disposal areas. Area D is also within the range safety fan for the north ammunition storage area where development is prohibited (**Figure 7-1** and **7-2**). A large on-base residential area is located to the west of Area D; it was expanded in 1998 and now houses approximately 3,500 residents. There are currently 828 housing units, of which 118 are vacant. When redevelopment of the housing area is completed in approximately 7 years, there will be 712 housing units.

ALGT is an off-base residential tract abutting the southwestern boundary of McChord Field that lies between JBLM property and Interstate 5. This tract consists of 1,183 housing units with approximately 3,400 residents.

In 1998 the former McChord AFB expanded its southwestern boundary into a portion of Area D/ALGT. This adjustment added 23 acres to base property, as indicated by the positions of the former and current base boundaries (**Figure 7-1**). As a result of the property acquisition, the portion of the groundwater plume above the MCL is within the installation boundary. **Figure 7-2** shows the current base boundary and the historical and current plume extents for TCE and cis-DCE.

On-base and off-base water supplies are not threatened because groundwater is withdrawn from deeper sources; however these wells are monitored as described in **Section 4.5.3**. McChord Field withdraws drinking water from deeper aquifers and has no extraction wells in the shallow, unconfined aquifer. The off-base residential area had drinking water wells installed in the shallow aquifer at the time of discovery. Subsequently, the residential area was connected to the Lakewood Water District Water Supply System that derives drinking water from a source away from the site, as described in **Section 7.1.5**.

7.1.3 Site Chronology

Table 7-1 provides a summary of events for the Area D/ALGT site.

Table 7-1. Chronology of Site Events for Area D/ALGT

Event	Date
Disposal activities at the site	1940s to early 1970s
Department of Defense Installation Restoration Program (IRP) initiated at McChord	1981
IRP Phase I—Records search	1982
IRP Phase II—Site investigation	1983
Discovery/Preliminary Assessment	1983
Final listing on EPA NPL	1984
Interim remedial activities—bottled water provided to private residences located within 5-micrograms per liter (µg/L) contour of the trichloroethene (TCE)	1984–1986
Remedial Investigation/Feasibility Study (RI/FS) negotiations completed	1988
Federal Facilities Agreement between Air Force, EPA, and Ecology finalized	1989
HHRA finalized	1990
Ecological Risk Assessment finalized	1991
RI/FS finalized	1991
Proposed Plan identifying EPA's preferred remedy presented to public; start of public comment period	1991

Event	Date
Record of Decision (ROD) signed	1991
Remedial Design completed	1991
Began on-site construction of groundwater containment and treatment system	1993
Completed connection of residents in ALGT to the public water system	1993
Containment system startup	1994
Operations and Maintenance (O&M) Plan approved by EPA	1994
Completed on-site construction of groundwater containment and treatment system	1994
Extraction well DX-1 shut down due to low concentrations in aquifer	1999
First Five-Year Review completed	2000
Extraction well DX-2 shut down due to low concentrations in aquifer	2003
Extraction well DX-2 pump replaced and returned to service due to resource protection well slightly above remediation goal	2004
Second Five-Year Review completed	2005
Sampling for 1,4-dioxane completed	2005
Identification and evaluation of alternatives to reduce source term and enhance dissolved plume remediation.	2010
Third Five-Year Review completed	2010
Bioenhancement Pilot Study Summary Report	2012
First Installation Wide (JBLM) Five-Year Review completed	2012
Well Installation and Source Zone Characterization Report	2013
Enhanced Amendment Delivery to Low-Permeability Zones for Chlorinated Solvent	2014
Technical Memorandum for Temporary Shutdown of the Area D/ALGT Groundwater Pump and Treat System (system shut down in August 2016)	2016
Groundwater Monitoring (GW) Plan Addendum for Area D/ALGT; including evaluation of the effectiveness of MNA as a potential remedy	2016

7.1.4 Initial Response

In 1984 to 1986 bottled water was provided to private residences located within the 5 μg/L isoconcentration contour for TCE. In 1986, prior to the 1991 ROD, the Air Force provided connections to the Lakewood Water District Water Supply System for households within the plume extent and completed additional connections by June 1993 for ALGT households that accepted the Air Force's offer of free connections.

7.1.5 Basis for Taking Action

A chlorinated solvent plume identified within Area D/ALGT Groundwater was the result of historical waste disposal practices. The nature and extent of the groundwater plume has been investigated and characterized based on several studies performed at the site. The following four COCs in groundwater were identified within the ROD for Area D/ALGT:

- 1,1-dichloroethene (1,1-DCE)
- *cis*-DCE
- TCE
- VC

Groundwater monitoring results reported in the RI showed that concentrations of TCE exceeding the MCL of 5 µg/L were present in a groundwater plume roughly 3,000 ft in length (see historical plume contour on **Figure 7-2**). A similar plume extent was identified for cis-DCE. Vinyl chloride and 1,1-DCE have also been identified as COCs in the ROD; however only occasional detections at trace levels have been reported.

The baseline HHRA (Ebasco, 1991a) determined that unacceptable risks exist for groundwater ingestion and groundwater inhalation by on-base residents and off-base residents and groundwater ingestion by long-term workers based on maximum detected contaminant concentrations.

The unacceptable risks for groundwater ingestion have been mitigated by prohibiting usage of the contaminated water as a drinking water source. Landfill 5 in Area D was identified as the source of the groundwater contamination, although source concentrations in soil were not identified. As no unacceptable human or ecological risk was identified for soil, surface water, or sediment (Ebasco, 1991a), the ROD determined remedial action was only needed for groundwater (EPA et al. 1991). The other six sites that comprise the Area D/ALGT site were determined to pose no unacceptable risk to human health or the environment; however, LUCs are still required over those landfills (**Figure 4-2**).

7.2 Remedial Actions: Area D/ALGT

7.2.1 Remedy Selection

A remedial action was required to restore the groundwater to its beneficial use as a drinking water aquifer. The ROD-selected remedy included,

- Pump-and-treat remedial action with installation of three groundwater extraction systems (designed and installed as one well per system) “to create a hydrologic barrier to prevent further off-base migration of contaminants above the MCLs and to treat the most contaminated groundwater beneath the Area D site,” with the expectation that the action would “remediate the contaminated plume off-site and on-site” (EPA et al. 1991).
- Groundwater monitoring
- Institutional controls
- Connection of ALGT households to the public water supply, if necessary

The RAO is to restore the groundwater to its beneficial use, a drinking water source. The cleanup goals are based on ARARs, either MCLs or MTCA Method B values.

Table 7-2. Groundwater Remediation Goals in ROD for Area D/ALGT

Contaminant of Concern	Groundwater Remediation Goal in µg/L[1]	Basis of Remediation Goal[2]
TCE	5	MCL
cis-DCE	70	MCL
1,1-DCE	0.07	MTCA Method B[3]

Vinyl chloride	0.04	MTCA Method B[3]

[1] Treatment plant effluent must meet the groundwater remediation goals, as well as meet the pH range of 6.5 to 8.5.

[2] Determination of remediation goals is presented in the ROD (EPA et al. 1991).

[3] Ecology MTCA Method B cleanup level for groundwater in 1991.

The ROD also stated that no remedial action was necessary for soil, surface water, or sediment.

7.2.2 Remedy Implementation

The selected remedy for the site, presented in the ROD, was Alternative 3; however, the groundwater pump and treat (GPT) system eventually installed was a hybrid of Alternatives 2 and 3 presented in the ROD.

The Area D/ALGT GPT system consists of three groundwater extraction wells (DX-1, DX-2 and DX-3), a groundwater treatment plant (Building 887) that utilizes two 20,000-pound vessels of GAC connected in series, and two recharge trenches. Extraction wells DX-1, DX-2, and DX-3 were designed with flow rates of 25, 40, and 75 gallons per minute (gpm), respectively. Extraction well DX-1 has remained off since 14 December 1999 after the Air Force and Ecology agreed that discontinuation of pumping from this well would have no adverse impact on hydraulic control of the TCE plume. The system location and layout are shown on **Figures 7-3a** and **7-3b**.

Prior to the 2016 system shutdown, the P&T system had been operating since 1994, containing the TCE plume to beneath the Whispering Firs Golf Course. Reduction in concentrations within the groundwater plume has allowed extraction well DX-1 to be placed on a standby “non-pumping status”. Historical extraction rates are presented on **Figure 7-4**. There had been no further substantial changes to the system until the GPT system was shutdown in August 2016. System shutdown details are provided in **Section 7.2.3**.

LUCs were implemented as described in the 2011 LUC Plan for McChord sites and included preventing residential land use and unplanned excavations within the boundaries of former disposal areas and preventing installation of new drinking water wells within 1,000 feet of these boundaries or within the footprint of the groundwater plume (**Figure 4-2**). The installation-wide LUC program is discussed in **Section 4.5.2**.

7.2.3 Operation and Maintenance

Pump and Treat System Operation

Prior to shutdown of the system in 2016, groundwater was extracted from well DX-2 (concentrations have been at or below the MCL of 5 µg/L), and from DX-3 (concentrations have been slightly above the MCL, with an average concentrations during 2015 of 8.4 µg/L). In 2015, the average influent concentration of TCE (water that is treated by the GAC system) was slightly above the MCL, with an average concentration of 7.2 µg/L.

The ALGT P&T system had run consistently since startup in February 1994 and through mid 2016. Operations followed the *Final Operation and Maintenance Plan* (USACE 1994a) and *Final Remedial Action Work Plan* (USACE 1994b), with updated procedures provided in yearly Quality Project Plans for the Groundwater Treatment Plant Monitoring and Optimization Program (latest version, Tetra Tech EC, Inc. 2015b).

Within the 2013 O&M report, declining production from extraction wells DX-2 and DX-3 was determined to be the result of fouled well screens. Wells DX-2 and DX-3 were rehabilitated in December 2013 in order to improve production. Well DX-2 stopped pumping in July 2013. Extraction well pumps were replaced at DX-2 and DX-3 in late December 2013 and started in January 2014. The heavily corroded galvanized steel riser at DX-2 was replaced with a stainless steel riser.

The 2015 Annual Report provided the following summary of conclusions for the GPT system.

- Based on the results of the groundwater monitoring, the ALGT GPT system is effectively containing the Area D groundwater plume.
- The GPT system treated approximately 46 million gallons of water during 2015 and removed approximately 3.14 pounds of TCE from the aquifer.
- Results for system samples indicate that a carbon change-out is not warranted at this time, even though the last carbon change-out was completed approximately 3.5 years ago.
- The status of the GPT can only be determined by visiting the site. Instrumentation that would provide remote notification of a GPT shutdown would improve the ability to maintain system operation. The notification system may be as simple as a flow switch in the influent line to the GPT. A "no-flow" condition could trigger an auto-dialer or wireless communication to notify system operators.

Land Use Controls
Annual LUC inspections had not been completed until the most recent January 2016 LUC inspection; however the 2011 LUC Plan for McChord sites was finalized in August 2011.

7.3 Progress Since Last Five-Year Review: Area D/ALGT

The protectiveness statement from the 2012 JBLM FYR was:

Subsite OU #	Protectiveness Determination	Protectiveness Statement
Area D/ALGT	Short-term Protective	The remedy at the ALGT site is protective in the short term for human health and the environment, and exposure pathways that could result in unacceptable risks are being controlled. In the off-base area of the ALGT, groundwater meets remediation goals (drinking water criteria).
	Protective	In order for the remedy to be protective in the long-term, the on-base remediation goal of restoring the aquifer to its beneficial use by meeting RAOs throughout the plume must be met. The Air Force (DoD) has provided permanent public water supply connections to residents and restricted the shallow aquifer to non-potable uses to control current threats at the site. Additionally, the RAO of restoring the

		aquifer to its beneficial use must be attainable in a reasonable timeframe. Alternative remedies should be pursued to further reduce plume dimensions and contaminant concentrations.

The recommendations from the previous Area D/ALGT FYR were:

Issue	Recommendations	Current Status	Current Implementation Status Description*	Completion Date (if applicable)
Continued reduction of the contaminant concentrations and the contaminant plume boundary is not being accomplished by the pump-and-treat remedy, potentially reducing the long term protectiveness of the remedy.	Continue to evaluate alternatives to reduce source term and enhance dissolved plume remediation, including verifying that the source area conceptual site model is correct	CompletedCompleted	Two additional studies have been completed along with completion of system shutdown and monitoring plans. Additional characterization and studies outlined in 2016 technical memoranda are intended to evaluate MNA as the final long-term remedy for Area D/ALGT.	Additional studies completed from 2012 to 2014. System shutdown in 2016. MNA and additional groundwater characterization /monitoring ongoing.
		Ongoing	Additional characterization and studies outlined in 2016 technical memoranda are intended to evaluate MNA as the final long-term remedy for Area D/ALGT	MNA and additional groundwater characterization /monitoring ongoing.

Well Installation and Source Zone Characterization (PNNL 2013)
Seven wells were installed near the downgradient edge of the source area as part of a study to support technology development and testing for a bioremediation approach using long-duration substrate and shear-thinning fluid (STF) additives to cut off the source area from the downgradient plume via an in situ permeable reactive barrier. Groundwater results indicated elevated TCE in a lower permeability muddy gravel zone located approximately 50 to 70 feet below ground surface. Concentrations of 1,1-DCE and VC were also observed, suggesting biological reduction in portions of the muddy gravel zone.

Wells that were installed for this project included DA-33 (DG-1), DA-34 (DG-2), DA-35 (DG-3), DA-36 (MW-1), DA-37 (INJ-1), DA-38 (MW-2), DA-39 (INJ-2). The designations in parentheses are the well numbers used for this study. These well locations are provided on **Figure 7-5** as PNNL Study Site wells.

Enhanced Amendment Delivery to Low-Permeability Zones for Chlorinated Solvent Source Area Bioremediation. ETCP Project No. ER-200913 (GSI and PNNL 2014)

The Environmental Security Technology Certification Program (ESTCP) funded a demonstration project to further evaluate the effectiveness of in-situ bioremediation to further treat chlorinated solvents at the LF-005/OT-039 source area (muddy gravel zone). An amendment solution containing substrate (ethyl lactate) and chloride as a tracer in an STF (xanthan gum) was injected at well DA-37 in September 2013, followed by 8 months of groundwater monitoring. Results indicated improved distribution of amendment to lower permeability zones using STF, reduction of TCE and daughter products, and enhanced persistence of the amendment within the treatment zone.

Complete removal of TCE was observed in the majority of wells in the treatment zone by 5 months, and no rebound in TCE concentrations was observed after 8 months of monitoring. TCE concentrations in downgradient wells (e.g., DG-1, DG-2, DG-3) were largely similar to pre-injection levels. Little total organic carbon was measured in downgradient wells, a pattern which is consistent with the persistence of the amendment within the treatment zone. Although not noted in the report, slight concentrations of 1,1-DCE were detected. 1,1-DCE is more often an abiotic breakdown project of 1,1,1-TCA than a biologically produced daughter.

Three multi-zone completion wells (CMT-1 to CMT-3) were installed under a variance issued by Ecology for the ESTCP study. The driller's logs submitted to Ecology indicated the CMT-1 to CMT-3 wells were designated as DA-40, DA-42, and DA-41, respectively, and had Ecology well tags BHN 963, BHN 965, and BHN 964. The CMT wells were installed in August 2013 and were decommissioned in October 2014. These well locations are provided on **Figure 7-5** as PNNL Study Site wells.

System Shutdown

In addition to some general equipment repair and updates, the 2015 Annual Report recommended to "*Proceed with documentation followed by interim shutdown of the GPT system, per the discussion and agreements made during the Federal Facilities Agreement meeting held in 27 January 2016*."

In May 2016, the Army conducted a Site Management Improvement Study (SMIS) to optimize the Area D/ALGT site. As a component of the SMIS, the Army recommended a short-term shutdown (e.g., 12 to 24 months) of the ALGT GPT system following the June 2016 quarterly sampling event with implementation of Monitored Natural Attenuation (MNA) sampling. The system was temporarily shut down in August 2016.

The purpose of the shutdown of the system is to evaluate contaminant rebound as well as to evaluate additional treatment options for the remaining residual groundwater contaminants at the site.

The rationale for system shutdown, as stated in the May 2016 SMIS, included:

- In 22 years of operation, the GPT system has treated approximately 1.35 billion gallons of water, while only removing approximately 105 pounds (or roughly 12 gallons) of TCE from the aquifer.
- Annual average influent concentrations of TCE in water treated by the GPT system have ranged between 6 and 9 µg/L for the past 10 years, only slightly above the MCL.
- Trend analysis of the groundwater data from site wells (collected since 1994) indicates that the TCE plume appears to have reached an asymptotic condition over the past 10 to 15 years.

- The historical TCE plume (presented in the RI and the ROD) would be contained within the current JBLM property boundary, without operation of the GPT system.

On a semiannual basis the GPT is scheduled to be energized for short periods (less than ½ hour) to ensure system components remain functional.

Groundwater Monitoring
Groundwater monitoring of the GPT system is currently conducted in accordance with the RAWP as modified over the 22 years of operation per agreements between Ecology and JBLM.

Compliance monitoring (as of mid 2016) included analysis of a specific subset of VOCs, including TCE, cis-DCE, 1,1-DCE, and VC. The current sample frequency is either quarterly (extraction wells DX-2 and DX-3, system effluent and monitoring points, and resource protection well DT-1), semiannually (resource protection wells DA-7b and DA-21b), or annually (resource protection wells DA-9b, DA-28, DA-29, DA-30a, DA-30b, DB-6, and DR-05).

The GW Monitoring Addendum, August 2016, documents quarterly groundwater sampling from the wells that will be sampled and analyzed for similar VOCs plus additional analytes to assess the effectiveness of MNA per the Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater (EPA 1988). MNA parameters include: anions (nitrate, sulfate, chloride), metals (total iron [Fe], ferrous iron [Fe(II)], manganese [Mn]), dissolved gases (hydrogen, methane, ethane), alkalinity, and TOC.

Per the August 2016 GW Monitoring Addendum, endpoints reached during the short-term shutdown (i.e., TCE trends, MNA assessment) will be summarized and presented to the regulatory agencies during the next FYR (or at an alternative project meeting if more appropriate).

Evaluating Transition from P&T to MNA
According to the Groundwater Monitoring Plan Addendum August 2016, six additional monitoring wells will be installed (**Figure 7-5**). The wells will support delineation of the mid-plume and source area of the TCE impacts to groundwater in the vicinity of Landfill 5. Wells will be screened from approximately 50 to 70 feet below grade. Data from the wells will support further identification of the width of the groundwater plume, determination of groundwater flow direction and velocity, and estimation of the mass flux of contaminants through the plume.

Three soil samples are planned to be collected from each boring and will be analyzed for TOC and VOCs (TCE, cis-DCE, 1,1-DCE, and VC) to document the presence or absence of these parameters in the muddy gravel zone.

Following completion of the field work, a Data Gap Report will be prepared to assist in refining the plume extent, evaluating remaining VOCs within the upper/finer grained aquifer materials (e.g., muddy gravels) underlying Site LF-005/OT-039, and estimating contaminant mass discharge. The hydraulic conductivity of the aquifer will be determined at individual wells using either slug tests or specific capacity tests.

The objectives of this project are to evaluate rebound in TCE concentrations in groundwater following temporary shutdown of the GPT system, further refine the source area at Area D, and determine the effectiveness of MNA to be used as a final remedy for the source area in achieving the remedial action objects in both the near-term and long-term time frames.

Decision Process
Groundwater data will be collected during 4 quarterly monitoring events. Based on the new quarterly groundwater data, it will be determined if the remedial technology (MNA) is performing at a level that will ensure that remedial objectives are met.

1. Select MNA as the sole remedy (usually following active remediation).
2. Select MNA as a component of the remedy in conjunction with one or more other remedial technologies.
3. Reject MNA and select another remedial technology.

The Progress towards meeting RAOs is discussed in **Section 7.4.2.4**.

7.4 Document and Data Review: Area D/ALGT

7.4.1 Document Review

Key installation-wide documents reviewed for this FYR can be found in **Section 3.5**. Site-specific documents reviewed include:

Area D/ALGT Operations and Maintenance Annual Reports (Various 1995 – 2015, see References)

Operations and maintenance (O&M) of the ALGT GPT system and associated resource protection wells is documented in annual reports as follows:

- CY 1994 and CY 1995. by Hart Crowser (reports issued in 1995, 1996)
- CY 1996 through CY 1999. by URS Greiner Woodward-Clyde and Foster Wheeler Environmental Corporation (reports issued in 1997, 1998, 1999, 2000)
- CY 2000. by FPM Group and Foster Wheeler Environmental Corporation (report issued in 2001)
- CY 2001 and CY 2002. by Foster Wheeler Environmental Corporation (reports issued in 2002, 2003)
- CY 2003 and CY 2004. by Tetra Tech FW, Inc. (reports issued in 2004, 2005)
- CY 2005 through CY 2011. by Tetra Tech EC, Inc. (reports issued in 2006, 2007, 2008, 2009, 2010, 2011a, and 2012)
- CY 2012 and CY 2013. by Versar, Inc. (reports issued in 2013, 2014)
- CY 2014. by Tetra Tech EC, Inc. (report issued in 2015)
- CY 2015 Draft. by JBLM (report issued in February 2016)

Air Force, 2000. Five-Year Review Report for the Area D/American Lake Garden Tract, National Priorities List Site, McChord Air Force Base, WA. February.

Environmental Management Branch, 1991. No Further Action Planned Site Close-Out, McChord Air Force Base, WA. September.

JBLM Public Works and Tetra Tech EC, Inc. 2010. Third Five-Year Review for Area D/American Lake Garden Tract, Joint Base Lewis McChord, McChord Field. March.

PNNL, 2013. Well Installation and Source Zone Characterization, American Lake Garden Tract, Area D, Joint Base Lewis McChord, WA. May.

GSI and PNNL, 2014. Enhanced Amendment Delivery to Low-Permeability Zones for Chlorinated Solvent Source Area Bioremediation. ETCP Project No. ER-200913. September.

Tetra Tech 2012. Bioenhancement Pilot Study Summary Report, Remedial Action – Operation of Area D/American Lake Garden Tract Groundwater Treatment Plant Operations, Maintenance, and Optimization (LF-5), JBLM McChord Field, WA. July.

Tetra Tech EC., 2015. Quality Project Plan / Work Plan, Remedial Action– Operations of Basewide Groundwater Monitoring (SS-34, WP-44, DP-60) and Base Boundary Monitoring; Area D/American Lake Garden Tract (LF-5) Groundwater Pump and Treat System; and SS-34N. October.

Tetra Tech EC., 2016a. Technical Memorandum for Temporary Shutdown of the Area D/ALGT Groundwater Pump and Treatment System. May.

Tetra Tech EC. 2016b. Draft Final Rev 1 Groundwater Monitoring Plan Addendum for Area D/ALGT, August.

USEPA et al. 1991. Record of Decision, McChord Air Force Base, Washington/American Lake Garden Tract (EPA, Air Force, and Washington State Department of Ecology 1991)

The following four documents were not provided for this FYR but may be referenced within this report:

Ebasco 1991b. Final Feasibility Study Report, McChord Air Force Base Area D/American Lake Garden Tract, prepared in association with Shannon & Wilson, Inc.

Ebasco 1991a. Final Remedial Investigation Report, McChord Air Force Base Area D/American Lake Garden Tract, prepared in association with Shannon & Wilson, Inc.

USACE Seattle District 1992. Final Design, Area D/American Lake Garden Tract, Groundwater Treatment, McChord Air Force Base, Washington

USACE Seattle District 1994. Final Remedial Action Work Plan, Area D/American Lake Garden Tract Groundwater Treatment, McChord Air Force Base, Washington

7.4.2 Data Review and Evaluation

7.4.2.1 Performance Monitoring

Prior to system shutdown, the GPT system was functioning as designed and has been effective in providing containment of the TCE plume. On average, the GPT system treated approximately 60 million gallons of groundwater annually and has treated approximately 1.35 billion gallons of groundwater since system startup in 1994.

Prior to system shutdown, the GPT system removed a nominal quantity (approximately 3 to 5 pounds per year) of TCE from the aquifer each year. Approximately 105 pounds (or roughly 12 gallons) of TCE have been removed from the aquifer during the 22 years of operation. Extraction well DX-2 continued to extract groundwater that contained TCE below the MCL (since system startup) while extraction well DX-3 continued to extract groundwater that contained TCE that is slightly above the MCL.

Early on, the system reduced the TCE groundwater plume from approximately 3,000 feet in length to a current length of approximately 1,400 feet. The plume size has remained consistent for the last 10-15 years. **Figure 7-2** shows the groundwater plume evolution.

7.4.2.2 TCE Trend Analysis

Statistical trend analyses were most recently performed using groundwater data from 2015 for nine resource protection wells: DA-7b, DA-9b, DA-21b, DA-28, DA-29, DA-30a, DA-30b, DB-6, and DR-05. No statistical analyses were performed for resource protection well EPA-W-5 because over half the data were non-detect.

Resource protection well DR-05 was the only well that exhibited an increase in TCE concentrations; however, the trend is not statistically significant. This trend is consistent with the 2014 trend. The highest concentration of TCE ever detected in samples from DR-05 was 3.3 μg/L in September 2001.

Resource protection wells DA-7b, DA-9b, and DB-6 have TCE data showing statistically significant downward trends. Resource protection wells DA-21b, DA-28, DA-29, DA-30a and DA-30b also have TCE data showing downward trends; however, these data are not statistically significant. These trends are consistent with the trends for 2014. The highest TCE concentrations are detected in DA-7b and DA-21b at 22 μg/L and 32 μg/L, respectively.

Plots of TCE concentrations in site wells from 1994 through 2015 and statistical figures for TCE are presented in Technical Memo for Temporary Shutdown (Tetra Tech EC, 2016a) and provided in **Appendix 4** of this FYR for reference. Trend analysis of the groundwater data from site wells (collected since 1994) indicates that the TCE plume appears to have reached an asymptotic condition over the past 10 to 15 years.

7.4.2.3 Annual Groundwater Monitoring

Groundwater monitoring of the GPT system is currently conducted in accordance with the RAWP as modified over the 22 years of operation per agreements between Ecology and JBLM. Per the August 2016 GW Monitoring Addendum, endpoints reached during the short-term shutdown (i.e., TCE trends, MNA assessment) will be summarized and presented to the regulatory agencies during the next Five-Year Review (or at an alternative project meeting if more appropriate).

7.4.2.4 Progress Towards RAOs

The 1991 ROD states that compliance with RAOs is expected within 50 years of remedy implementation (or 2044). After the first several years in operation, the system had contained and reduced the footprint of the plume to the original on-site boundary but no significant reduction in plume size or concentration has resulted since the late 1990's. Current data for the remedy offer no evidence that the source is decreasing at a significant rate.

As allowed by the ROD, see Selected Remedy Section, the GPT system was not modified but shutdown and MNA monitoring is being implemented. The purpose of the shutdown of the system is to evaluate contaminant rebound as well as to evaluate additional treatment options for the remaining residual groundwater contaminants at the site.

7.5 Technical Assessment: Area D/ALGT

7.5.1 Question A

Is the remedy functioning as intended by the decision documents?

Yes.

7.5.1.1 Remedial Action Performance

The purpose of the GPT remedy is to create a hydrologic barrier to prevent further off-base migration of contaminants at concentrations above MCLs and to treat the most contaminated groundwater beneath Area D. Containment of the plume is being achieved, although it appears that operation of the GPT system is not needed to contain off-base migration of contaminants exceeding the MCLs. The RAO states that the goal of this remedial action is to restore groundwater to its beneficial use, a potential drinking water source, and that the plume will be monitored to ensure that groundwater remediation goals are achieved and maintained throughout the contaminant plume. The remedy has successfully reduced the TCE plume area, and the Army is evaluating alternative remedies to efficiently treat the groundwater to below drinking water standards.

While operation of the GPT system has resulted in a reduced areal extent of the TCE plume exceeding 5 µg/L (**Figure 7-2**) limited reductions in areal extent have been observed since the late 1990s. The annual mass recovered through the GPT continues to slowly decline with approximately two to four lbs of TCE recovered annually since 2012 and over 45 million gallons pumped in 2015 (**Appendix 4**). Additionally, influent concentration of TCE in extraction wells DX-2 and DX-3 are relatively similar to concentrations observed since the mid to late 1990s (**Appendix 4**). Time series concentration charts and statistical analyses for monitoring wells within the interior of the groundwater plume (**Appendix 4)** indicate some wells show statistically significant declining trends for TCE (DA-7b, DA-9b, DB-6) while others do not exhibit statistically significant trends (DA-21b and DA-29).

7.5.1.2 Operations and Maintenance

The system has contained the contaminant plume and was shutdown in 2016 based on lack of significant change in plume size and concentration in the last 10-15 years.

From the 2014 Annual O&M Report, production at extraction wells DX-2 and DX-3 steadily decreased for the past few years. The pumps were removed and extraction wells DX-2 and DX-3 were rehabilitated in December 2013.

Following system shutdown, groundwater data will be collected during four quarterly monitoring events. Based on the new quarterly groundwater data, it will be determined if the remedial technology (MNA) is performing at a level that will ensure that remedial objectives are met.

7.5.1.3 Opportunities for Optimization

Further system/site changes or optimization will be made based on continued groundwater monitoring data and additional site characterization data.

7.5.1.4 Early Indicators of Potential Issues

No early indicators of potential issues were identified.

7.5.1.5 Implementation of Land Use Controls and Other Measures

Annual JBLM LUC inspection checklists (included in the JBLM LUC Plan dated 2011 and 2014) did not include McChord ALGT. However, ALGT is present on the completed January 2016 LUC checklist provided in **Appendix 3**. According to JBLM, LUC checklists for McChord ALGT prior to 2016 inspection were not found, although a McChord CERCLA LUC Plan was in place beginning in 2011.

This FYR team's inspection and the 2016 LUC checklist inspection verified that JBLM prevented residential land use and unplanned excavation in the former disposal areas shown on **Figure 4-2** and installation of new drinking water in areas shown on **Figure 4-2**.

7.5.2 Question B

Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Yes. There have been changes to risk assessment methods, exposure assumptions, and toxicity factors, but these do not call the protectiveness of the remedy into question. ARARs have not changed since the original risk assessment. Comparison of cleanup levels to current RSLs indicate that risks fall within acceptable ranges. The RAOs for preventing exposure of human and ecological receptors to contaminated groundwater are valid. Overall, no changes have occurred that call the protectiveness of the remedy into question.

Changes in Risk Assessment Methods and Exposure Assumptions
A number of changes in risk assessment methods, exposure assumptions, and toxicity values have taken place since the ALGT ROD. These changes are summarized in **Appendix 5**. The risks associated with the RGs of ALGT groundwater are summarized in **Table 3-1**. The RSL Calculator is used to calculate the risks associated with the RGs based on current risk assessment practice in terms of equations, exposure factors, and toxicity values. These changes have not been significant enough to call the protectiveness of the remedy into question.

Prior to 2010 FYR, McChord AFB completed modeling for evaluation of inhalation risks associated with a higher concentration TCE plume at ALGT which yielded vapor concentrations below MTCA regulatory limits. A copy of the model was not available for review.

Since 2010, EPA has finalized its VI technical guide (USEPA, 2015b). Based on March 2015 site groundwater data, the highest TCE concentrations are detected in DA-7b and DA-21b at 22 µg/L and 32 µg/L, respectively. Using the EPA VISL calculator (May 2016, Version 3.5.1), the VI carcinogenic risk for indoor inhalation of vapors from the Vashon aquifer is within USEPA's acceptable target risk range for carcinogens, between 10^{-4} to 10^{-6} for both commercial and residential scenarios. However, the target hazard quotient of 1.0 for non-carcinogenic was exceeded for both commercial and residential scenarios using these TCE concentrations. These risk values are calculated using conservative standard exposure scenarios such as people living in a house for 25 to 70 years which may not be applicable for this site.

Recalculating the EPA VI risk based on where buildings and residences are located with respect to the plume yields a VI carcinogenic risk and non-carcinogenic risk within acceptable levels. Because these structures are outside the 5.0 µg/L isoconcentration contour by more than 100 feet, 5.0 µg/L was inputted into the EPA VI screening level calculator. As shown on **Figure 7-5**, the golf course club house is over 400 feet from DA-7b and approximately 250 feet from the 5.0 µg/L TCE isoconcentration contour. Concentrations decrease toward the club house building.

The new single-family residential housing area south of Lincoln Boulevard SW and Whispering Firs Golf Course is approximately 300 feet south of the current 5.0 ppb TCE contour line (as measured from the nearest house). This is based on TCE isoconcentration contours shown on **Figure 7-5**.

Current protectiveness is maintained as there are no structures above the TCE plume as defined by the 5.0 µg/L isoconcentration line. While there are LUCs in place restricting new construction over ALGT landfills, there are no environmental LUCs preventing construction over the ALGT TCE plume. The golf course, however, which encompasses the ALGT TCE plume, is within the range's safety fan for the north ammunition storage area where development is prohibited. Therefore, future protectiveness is still being achieved.

Changes in ARARs and TBCs

For groundwater in the ALGT, MCLs are identified as the ARAR. The RGs for TCE and cis-DCE at the site were set at the MCLs in place at the time of the ROD, which are compared to current MCLs in **Table 3-1**. These values have not changed. The RGs for vinyl chloride and 1,1-DCE were set at the MTCA Method B levels based on 10^{-6} cancer risk in the ROD. The current MTCA Method B level for vinyl chloride has decreased slightly to 0.029 µg/L while 1,1-DCE is no longer considered carcinogenic and has a much higher MTCA Method B non-cancer based level of 400 µg/L.

Changes in RAOs

The RAO to restore drinking water to its beneficial use remains valid as the selected remedy was selected to prevent exposure to groundwater contaminants by human and ecological receptors and minimizes migration of contamination. By eliminating unacceptable risks, the RAO ensures the remedy remains protective of human health and the environment until the contaminated groundwater is restored to its designated use.

Emerging Contaminants

PFASs:
The presence of PFASs at or near the ALGT has not been evaluated. The ALGT GPT system has the potential to intercept groundwater containing PFASs, whether a result of historical contamination at ALGT landfills or more broad PFASs contamination at JBLM which will be further defined through the SI process (discussed in **Section 3.6.1**). If PFASs are present above the LHA level, and the treatment system is not configured to adequately treat PFASs prior to discharging, protectiveness may be affected. ALGT discharges treated groundwater to infiltration trenches near the groundwater treatment building (**Figure 7-3a**). Reinjection of groundwater with PFASs above the LHA level could result in redistribution of PFASs. Therefore, due to the unknown presence of PFASs at the influent and effluent of the pump and treat system and corresponding discharge locations, a protectiveness determination cannot be made until further information is obtained.

1,4-Dioxane:
Monitoring for 1,4-dioxane was conducted in 2005 in response to a previous FYR recommendation. Results were below the practical quantitation limit (PQL) of 5 µg/L according to previous FYRs; however the data were unavailable for this review. Because the MTCA Method B limit has been lowered to 0.44 µg/L, which is based on a 10^{-6} cancer risk, the corresponding risk of a detection at 5 µg/L was evaluated. The cancer risks from 1,4-dioxane occurring below the PQL do not exceed 1.2×10^{-5}, which falls well within the "acceptable" cancer risk range. Therefore, 1,4-dioxane if present below the PQL would not call the protectiveness of the remedy into question.

7.5.3 Question C

Has any other information come to light that could call into question the protectiveness of the remedy?

No.

7.5.3.1 Ecological Risks

No other information has come to light that could call the protectiveness of the remedy for ecological receptors into question.

7.5.3.2 Natural Disasters

No natural disasters have occurred that could call the protectiveness of the remedy into question.

7.5.3.3 Any Other Information That Could Call Into Question the Protectiveness of the Remedy

No other information was discovered during the review period that could call the protectiveness of the remedy into question.

7.5.4 Summary of Technical Assessment

The remedy has been implemented and operated as intended by the ROD. The GPT system containing the contaminant plume was shutdown in 2016 based on lack of significant change in plume size and concentration in the last 10-15 years. Review of additional groundwater and soil data collected after the shutdown will determine whether the GPT system can be permanently shutdown and if MNA is performing at a level that will ensure that remedial objectives are met. The potential presence of PFASs within groundwater intercepted by the GPT system, whether as a results of ALGT landfills or broader installation-wide PFASs contamination, poses the risk of redistributing PFASs at the point of reinjection. The presence of PFASs must therefore be evaluated before a protectiveness determination can be made. The LUC inspections along with land use and water well restrictions ensure LUCs remain effective at restricting potential exposure to contaminated groundwater. Exposure assumptions made in the ROD remain valid, and no changes to risk assessment, toxicity data, or cleanup levels have occurred which impact the protectiveness of the remedy.

7.6 Issues: Area D/ALGT

The following issue discussed in **Section 7.5.2** may affect the protectiveness and must therefore be evaluated before a protectiveness determination can be made

Issues	Affects Protectiveness (Y/N)	
	Current	Future
1. Groundwater extraction and treatment system (currently shutdown) has the potential to intercept groundwater containing PFASs. If present, reinjection may be redistributing PFASs.	TBD	TBD

7.7 Recommendations and Follow-up Actions: Area D/ALGT

Recommendations / Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
				Current	Future
1. Evaluate presence of PFASs at ALGT through collection of groundwater samples from three wells within the footprint of the groundwater plume including one near the infiltration trenches. If operation of the ALGT GPT system is resumed, then samples from the influent and effluent should assessed for PFASs.	U.S. Army	USEPA	2020	TBD	TBD

7.8 Protectiveness Statement: Area D/ALGT

A protectiveness determination for the OU-3 – ALGT remedy cannot be made at this time until further information is obtained. Further information will be obtained by taking the following action: an investigation and evaluation of the presence of PFASs within the GPT system at the ALGT. It is expected that this action will take approximately three years to complete, at which time a protectiveness determination will be made.

8.0 Site-wide Protectiveness Statement

The remedial action at OU2 currently protects human health and the environment. However, because a protectiveness determination of the remedies at OU1 and OU3 cannot be made at this time, the protectiveness determination for the site is deferred until further information is obtained. Further information will be obtained by investigating and evaluating the presence of PFASs within the three pump and treat systems at the Logistics Center (OU1) and within the GPT system at the ALGT (OU3). It is expected that these actions will take approximately three years to complete, at which time a protectiveness determination will be made. In addition, in order for the remedy at the SRCPP (OU2) to be protective in the long-term, the prevention of residential land use needs to be incorporated into the JBLM LUC Plan and annual inspection checklists to ensure protectiveness.

9.0 Next Review

The next FYR is due September 2022, five years from the date of this review.

10.0 References

All references for site-specific documents are included within their respective sections. Additional documents referenced in this document include:

Bussey, Troy, Jr., Fort Lewis Public Works Contractor. 2007a. *Draft Site Investigation Report, Industrial Wastewater Treatment Plant Site, Fort Lewis Washington.* December 2007.

Environmental Management Branch, 1991. No Further Action Planned Site Close-Out, McChord Air Force Base, WA. September.

KEMRON Environmental Services, Inc. 2010a. Final Draft Technical Memorandum, Fire Training Pit, Park Marsh, Pesticide Rinse Area, Illicit PCB Dump, Landfill 1, Explosive Ordnance Demolition Site 62, Joint Base Lewis-McChord, Washington. Prepared for JBLM – Public Works–ED and ACA Aberdeen Proving Ground – W91ZLK. October 2010.

KEMRON Environmental Services, Inc. 2010b. Final Draft Explanation of Significant Differences Logistics Center NPL Site, Joint Base Lewis-McChord, Washington. (Pertains to Sites (DRMO Yard, Landfill 6, Stormwater Outfall #7/Settling Basin (aka IWTP), Battery Acid Pit, Well LC-6 and Pit Area). October 2010.

United States Environmental Protection Agency (USEPA), 2001. Comprehensive Five-Year Review Guidance, OSWER Directive 9355.7-03B-P. June. *(and subsequent updates)*

USEPA, 2010. Interim Final Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites (OSWER 9355.0-89, EPA 540-F-00-005)

USEPA, 2011. Enforcing Five-Year Review Requirements under Federal Facility Requirements. Memorandum. July 21

USEPA 2011. Program Priorities for Federal Facility Five-Year Review. Memorandum to Superfund National Policy Managers Regions 1-10. August 1.

USEPA, 2011. Recommended Evaluation of Institutional Controls: Supplement to the "Comprehensive Five-Year Review Guidance," OSWER Directive 9355.7-18. September.

USEPA, 2012a. Correction to the Memorandum "Program Priorities for Federal Facility Five-Year Review" Memorandum to Superfund National Policy Managers, Regions 1-10. February 22.

USEPA, 2012b. Memorandum to National Superfund Program Managers: Clarifying the Use of Protectiveness Determinations for Comprehensive Environmental Response, Compensation and Liability Act Five-Year Reviews. September 23.

USEPA, 2012c. Assessing Protectiveness at Sites for Vapor Intrusion Supplement to the "Comprehensive Five-Year Review Guidance" OSWER Directive 9200.2-84. November.

USEPA, 2015a. Ground Water Technical Considerations during the Five-Year Review Process. EPA-542-F-15-010. April.

USEPA, 2015b. Office of Solid Waste and Emergency Response (OSWER) Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air.

OSWER Publication 9200.2-154. June.

USEPA, 2015c. Preliminary Close Out Report Joint Base Lewis McChord Logistics Center National Priorities List Site. September.

USEPA, 2016. Regional Screening Levels. May.

Appendix 1

Tables

Table 3-1
Comparison of Site Cleanup Levels to Current, Risk-Based Screening Values, and other chemical ARARs
Joint Base Lewis-McChord
Pierce County, New Jersey

Constituent of Concern	Media	ROD / DD SCL		ROD / DD SCL Basis	Federal MCL (as of 2016)		Applicable WA Standard[1]		WA ARAR Basis	Federal Tapwater RSL / Industrial Soil RSL		C/N	Risk Associated with ROD/DD SCL		Acceptable Risk?
Logistics Center													Cancer	Non-Cancer HQ	
cis-1,2-dichloroethene	GW	70	ug/L	Federal MCL	70	ug/L	70	ug/L	2015 WA MCL	***36***	µg/l	N	--	1.2	Yes
tetrachloroethene	GW	5	ug/L	Federal MCL	5	ug/L	5	ug/L	2015 WA MCL	11	µg/l	C	$4.4x10^{-7}$	0.12	Yes
trichloroethene	GW	5	ug/L	Federal MCL	5	ug/L	5	ug/L	2015 WA MCL	***0.49***	µg/l	C	$1.0x10^{-5}$	1.8	No, see note 2
1,1,1-trichloroethane[3]	GW	--			200	ug/L	200	ug/L	2015 WA MCL	8000	µg/l	N	--	--	--
vinyl chloride[3]	GW	--			2	ug/L	0.2	ug/L	2015 Method A	0.019	µg/l	C	--	--	--
cis-1,2-dichloroethene[3]	SW	--			70	ug/L	70	ug/L	2015 WA MCL	36	µg/l	N	--	--	--
trichloroethene	SW	80	ug/L	unknown	5	ug/L	2.5	ug/L	2015 WA HH Fresh Water CWA §304	***0.49***	µg/l	C	$1.6x10^{-4}$	28	No, see note 2
Landfill 4															
trichloroethene	GW	5	ug/L	Federal MCL	5	ug/L	5	ug/L	2015 WA MCL	***0.49***	µg/l	C	$1.0x10^{-5}$	1.6	No, see note 2
vinyl chloride	GW	1	ug/L	MTCA Method B	2	ug/L	0.029	ug/L	MTCA Method B (2015 WA MCL: 2.0)	***0.019***	µg/l	C	$5.33x10^{-5}$	0.0023	Yes
SRCPP															
cPAHs	soil	1	mg/kg	MTCA Method B	--	--	0.14	mg/kg	2015 MTCA Method B for benzo(a)pyrene	0.29	mg/kg	C	$6.36x10^{-5}$	--	Yes
cPAHs	GW	0.1	ug/L	MTCA Method C	0.2	ug/L	0.2	ug/L	2015 WA MCL (0.12 ug/L for Method C)	***0.0034***	µg/l	C	$2.91x10^{-5}$	--	Yes
manganese	GW	80	ug/L	Federal MCL	--	ug/L	2,240	ug/L	2015 MTCA Method B	430	µg/l	N	--	0.185	Yes
Landfill 1															
trichloroethene	GW	5	ug/L	Federal MCL	5	ug/L	5	ug/L	2015 WA MCL	***0.49***	µg/l	C	$1.0x10^{-5}$	1.6	No, see note 2
American Lakes Garden Tract															
trichloroethene	GW	5	ug/L	Federal MCL	5	ug/L	5	ug/L	2015 WA MCL	***0.49***	µg/l	C	$1.0x10^{-5}$	1.6	No, see note 2
cis-1,2-dichloroethene	GW	70	ug/L	Federal MCL	70	ug/L	70	ug/L	2015 WA MCL	***36***	µg/l	N	--	1.2	Yes
vinyl chloride	GW	0.04	ug/L	MTCA Method B	2	ug/L	0.029	ug/L	MTCA Method B (0.2 ug/L for 2015 WA MCL)	***0.019***	µg/l	C	$2.13x10^{-6}$	$6.7x10^{-4}$	Yes
1,1-dichloroethene	GW	0.07	ug/L	MTCA Method B	7	ug/L	400	ug/L	MTCA Method B (7 ug/L for 2015 WA MCL)	280	µg/l	N	--	$7.0x10^{-5}$	--

Table 3-1
Comparison of Site Cleanup Levels to Current, Risk-Based Screening Values, and other chemical ARARs
Joint Base Lewis-McChord
Pierce County, New Jersey

Notes:

Illicit PCB Dump Site, Battery Acid Pit, DRMO Yard, and Pesticide Rinse Area - No COCs, cleanup standards, or cleanup ARARs were identified in the DDs.

Federal Maximum Contaminant Level obtained from https://www.epa.gov/ground-water-and-drinking-water/table-regulated-drinking-water-contaminants

Washington State cleanup levels obtained from: https://fortress.wa.gov/ecy/clarc/CLARCDataTables.aspx

USEPA Regional Screening Levels obtained from https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016

[2] The remedy prevents exposure through groundwater use restrictions

[3] The SCL was not included in the ROD

Bold/Italic = The risk associated with the SCLs for these constituents exceeds 10^{-4} and/or the hazard index slightly exceeds 1, assuming use of groundwater as a potable water source or assuming full time industrial exposure to soil. Current land use controls prevent exposure (e.g. cap, excavation restriction, land use restrictions, groundwater use restrictions, etc)

ug/l = microgram per liter

ARAR = applicable or relevant and appropriate requirements

C = screening level based on lifetime excess cancer risk of 1E-6

DD = Decision Document

GW = Groundwater

MCL = Maximum Contaminant Level (Federal)

N = screening level based on noncancer hazard quotient of 1

ROD = Record of Decision

RSL = USEPA Regional Screening Level (May 2016 update)

SCL - Site Cleanup Level

Table 3-2. Perfluorochemical Groundwater Results from On-Post Water Supply Wells - 2016
Joint Base Lewis McChord

Garrison/Installation/ Site/Facility Address	Well ID	Well ID - Map	Well Depth (Feet)	Groundwater Elevation (feet)	Casing Depth (feet)	Casing Diameter (inches)	Perforated Zones (feet)	Capacity (gpm)	Analyte	Unit	Sample Date (April 2016) Lab-ARI	Sample Date (November 2016) Lab-APH	Sample Date (November 2016) Lab-ARI
JBLM/McChord/S 03, East Well, Bldg 190	East Well	East Well	550	300	550	16	201-210, 217-220, 245-250, 417-470, 481-490, 492-498	966	PFOS	ug/L	0.0434	0.0332	0.034
									PFOA	ug/L	0.00492	0.00463	0
									PFOA + PFOS	*ug/L*	***0.04832***	*0.03783*	*0.034*
JBLM/McChord/S 08, Housing Well 1, Bldg 5001	Housing Well 1	Housing Well I	435	277	358	18, 12	94-96, 138-140, 150-154, 220-254	500	PFOS	ug/L	nd	0.00292	nd
									PFOA	ug/L	nd	0	nd
									PFOA + PFOS	*ug/L*	*nd*	*0.00292*	*nd*
JBLM/McChord/S 07, Housing Well 2, Bldg 5003	Housing Well 2	Housing Well II	220	280	205	12	205-220	450	PFOS	ug/L	nd	0.00317	nd
									PFOA	ug/L	nd	0	nd
									PFOA + PFOS	*ug/L*	*nd*	*0.00317*	*nd*
JBLM/McChord/S 06, Housing Well 3, Bldg 3410	Housing Well 3	Housing Well III	216	280	197	12	197-216	1250	PFOS	ug/L	ns	0.003	nd
									PFOA	ug/L	ns	0	nd
									PFOA + PFOS	*ug/L*	*ns*	*0.003*	*nd*
MAMC, Well 4 / S15 / 292 ft, Bldg 0962	--	MAMC-4	--	--	--	--	--	--	PFOS	ug/L	nd	nd	nd
									PFOA	ug/L	nd	nd	nd
									PFOA + PFOS	*ug/L*	*nd*	*nd*	*nd*
JBLM/McChord/S 09, Mars Hill, Bldg 830	Mars Hill	Mars Hill Well	141	360	141	6	--	--	PFOS	ug/L	0.0139	nd	nd
									PFOA	ug/L	0.0548	nd	nd
									PFOA + PFOS	*ug/L*	*0.0687*	*nd*	*nd*
JBLM/McChord/S 01, North Well, Bldg 711	North Well	North Well	200	300	195	12	145-150, 152-165, 170-180,	750	PFOS	ug/L	0.193	0.201	0.16
									PFOA	ug/L	0.0114	0.0153	0.014
									PFOA + PFOS	*ug/L*	***0.2044***	***0.2163***	***0.174***
JBLM/McChord/S 02, South Well, Bldg 781	South Well	South Well	298	300	292	12	140-153, 165-182, 264-278	683	PFOS	ug/L	ns	0.233	0.21
									PFOA	ug/L	ns	0.0172	0.018
									PFOA + PFOS	*ug/L*	*ns*	***0.2502***	***0.228***
JBLM/McChord/S 11, Replacement Well 1, Bldg 568	Replacement Well 1	Replacement Well I	688	303	823	12	593-681	400	PFOS	ug/L	0.0661	nd	nd
									PFOA	ug/L	0.00935	nd	nd
									PFOA + PFOS	*ug/L*	*0.07545*	*nd*	*nd*
JBLM/McChord/S 12, Replacement Well 2, Bldg 512	Replacement Well 2	Replacement Well II	828	311	800	12	800-828	0	PFOS	ug/L	ns	ns	ns
									PFOA	ug/L	ns	ns	ns
									PFOA + PFOS	*ug/L*	*ns*	*ns*	*ns*

Table 3-2. Perfluorochemical Groundwater Results from On-Post Water Supply Wells - 2016
Joint Base Lewis McChord

Garrison/Installation/ Site/Facility Address	Well ID	Well ID - Map	Well Depth (Feet)	Groundwater Elevation (feet)	Casing Depth (feet)	Casing Diameter (inches)	Perforated Zones (feet)	Capacity (gpm)	Analyte	Unit	Sample Date (April 2016) Lab-ARI	Sample Date (November 2016) Lab-APH	Sample Date (November 2016) Lab-ARI
JBLM/McChord/S 04, Sage Well #1, Bldg 846	Sage Well #1	Sage Well I	158	277	137	12	137-158	500	PFOS	ug/L	nd	0.00619	nd
									PFOA	ug/L	nd	0	nd
									PFOA + PFOS	*ug/L*	*nd*	***0.00619***	*nd*
JBLM/McChord/S 05, Sage Well #2, Bldg 847	Sage Well #2	Sage Well II	250	277	207	8	35-69	100	PFOS	ug/L	nd	ns	ns
									PFOA	ug/L	nd	ns	ns
									PFOA + PFOS	*ug/L*	*nd*	*ns*	*ns*
JBLM / Main North / S 01, Sequalitchew Spring, Bldg 7973	Sequalitchew Spring	Sequalitchew Spring	--	--	--	--	--	9600	PFOS	ug/L	0.0121	0.0124	nd
									PFOA	ug/L	0.00553	0.00724	nd
									PFOA + PFOS	*ug/L*	*0.01763*	*0.01964*	*nd*
JBLM / Main North / S 06, Well #12A, Bldg 07980	Well #12A	Well 12A	--	--	--	--	--	1400	PFOS	ug/L	0.013	ns	nd
									PFOA	ug/L	0.00649	ns	nd
									PFOA + PFOS	*ug/L*	*0.01949*	*ns*	*nd*
JBLM / Main North / S 11, Well #12B, Bldg 07977	Well #12B	Well 12B	--	--	--	--	--	1300	PFOS	ug/L	0.0104	ns	nd
									PFOA	ug/L	0.00462	ns	nd
									PFOA + PFOS	*ug/L*	*0.01502*	*ns*	*nd*
JBLM / Main North / S 10, Well #13, Bldg 06994	Well #13	Well 13	275	175	--	--	190/200; 207/217; 239/240	950	PFOS	ug/L	0	nd	nd
									PFOA	ug/L	0.0035	nd	nd
									PFOA + PFOS	*ug/L*	*0.0035*	*nd*	*nd*
JBLM / Main North / S 01, GC, Bldg 01542	Golf Course	Well 22	--	--	--	--	--	--	PFOS	ug/L	0.0141	0.00967	0
									PFOA	ug/L	0.062	0.0496	0.06
									PFOA + PFOS	*ug/L*	***0.0761***	***0.05927***	***0.06***
JBLM / Main North / S 09, Well #17, Bldg 04178	Well #17	Well 17	550	61	--	--	460-480	500	PFOS	ug/L	0.0271	0.0198	0.022
									PFOA	ug/L	0.0588	0.052	0.065
									PFOA + PFOS	*ug/L*	***0.0859***	***0.0718***	***0.087***
JBLM / Main North / S 14, Well #20, Bldg 03503	Well #20	Well 20	700	223	--	--	520-600	1650	PFOS	ug/L	nd	nd	nd
									PFOA	ug/L	nd	nd	nd
									PFOA + PFOS	*ug/L*	*nd*	*nd*	*nd*
JBLM / Main North / S 02, ASP1, Bldg M0075	ASP1	Well 23	--	--	--	--	--	--	PFOS	ug/L	nd	nd	nd
									PFOA	ug/L	nd	nd	nd
									PFOA + PFOS	*ug/L*	*nd*	*nd*	*nd*
JBLM / Main North / S 02, ASP2, Bldg M0090	ASP2	Well 10	--	--	--	--	--	--	PFOS	ug/L	nd	nd	nd
									PFOA	ug/L	nd	nd	nd
									PFOA + PFOS	*ug/L*	*nd*	*nd*	*nd*

Table 3-2. Perfluorochemical Groundwater Results from On-Post Water Supply Wells - 2016
Joint Base Lewis McChord

Garrison/Installation/ Site/Facility Address	Well ID	Well ID - Map	Well Depth (Feet)	Groundwater Elevation (feet)	Casing Depth (feet)	Casing Diameter (inches)	Perforated Zones (feet)	Capacity (gpm)	Analyte	Unit	Sample Date (April 2016) Lab-ARI	Sample Date (November 2016) Lab-APH	Sample Date (November 2016) Lab-ARI
JBLM / Main North / S 01, Range 17, Bldg U017C	Range 17	Well 24	--	--	--	--	--	--	PFOS	ug/L	nd	nd	nd
									PFOA	ug/L	nd	nd	nd
									PFOA + PFOS	*ug/L*	*nd*	*nd*	*nd*
JBLM / Main North / S 02, Well #14	--	Well 14	354	137	--	--	405-435	1000	PFOS	ug/L	ns	0.0287	0.029
									PFOA	ug/L	ns	0.0134	0.015
									PFOA + PFOS	*ug/L*	*ns*	***0.0421***	***0.044***

Notes:
nd - non detect
ns - not sampled
PFOA - perfluorooctanoic acid
PFOS - perfluorooctane sulfonate

Bold	PFOA + PFOS > 40 parts per trillion
Bold	Bold - PFOA + PFOS > 70 parts per trillion

Appendix 2

Figures

Appendix 2 – Figures

Figure 1-1 - JBLM Location and Vicinity Map

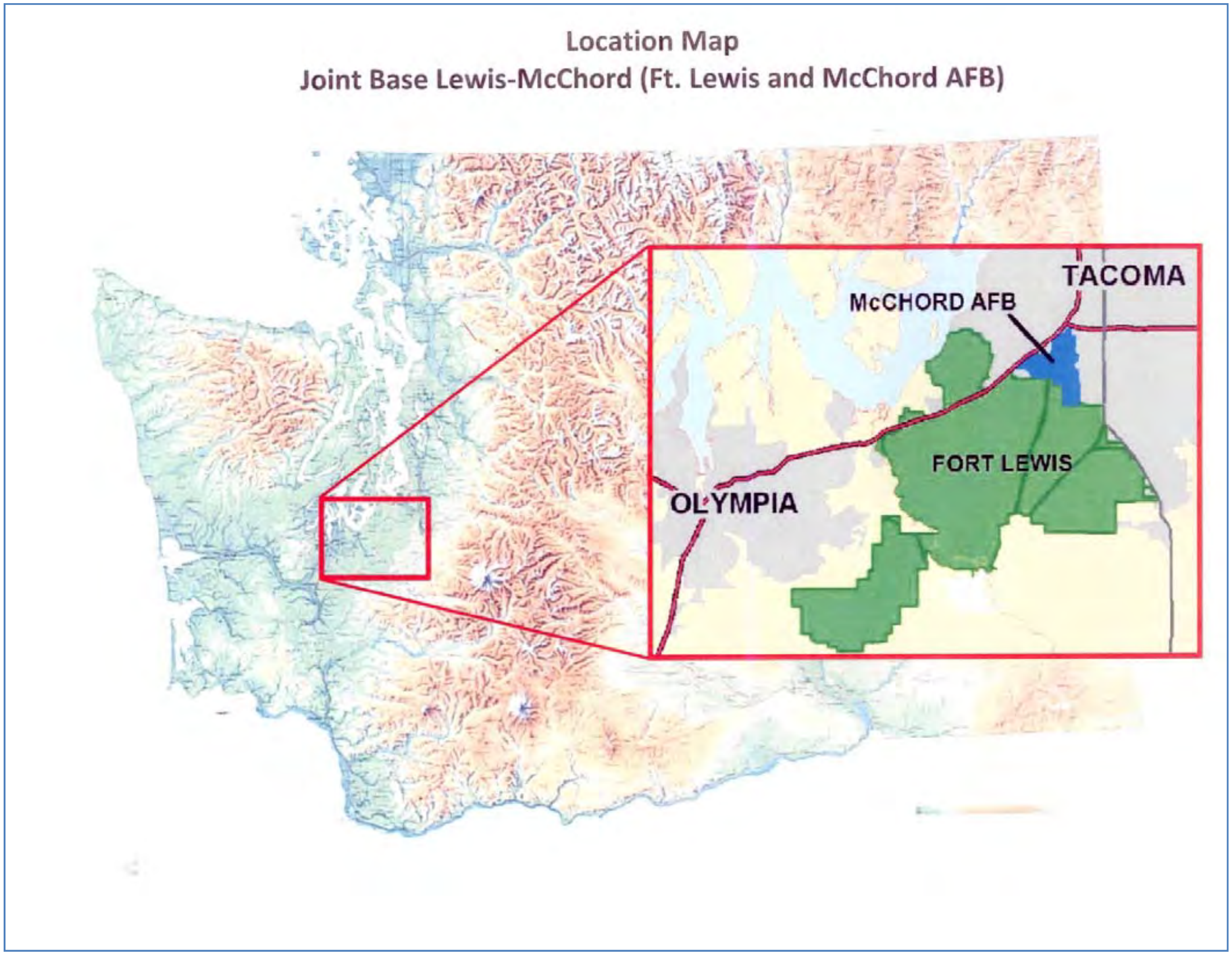


Figure 1-1
JBLM Site Location Map

Figure 3-1: PFOA & PFOS Concentration in JBLM Drinking Water Wells - November 2016

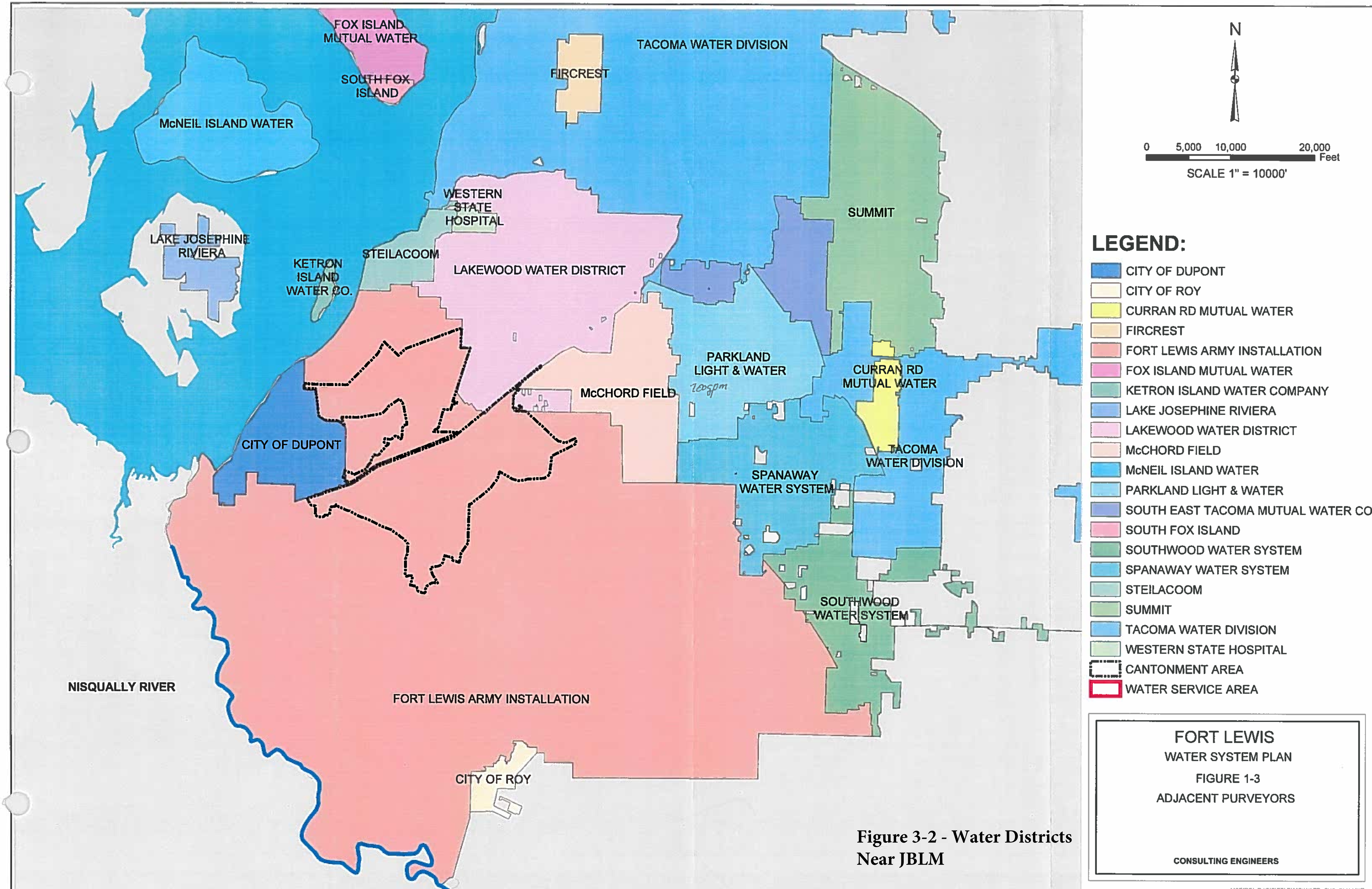
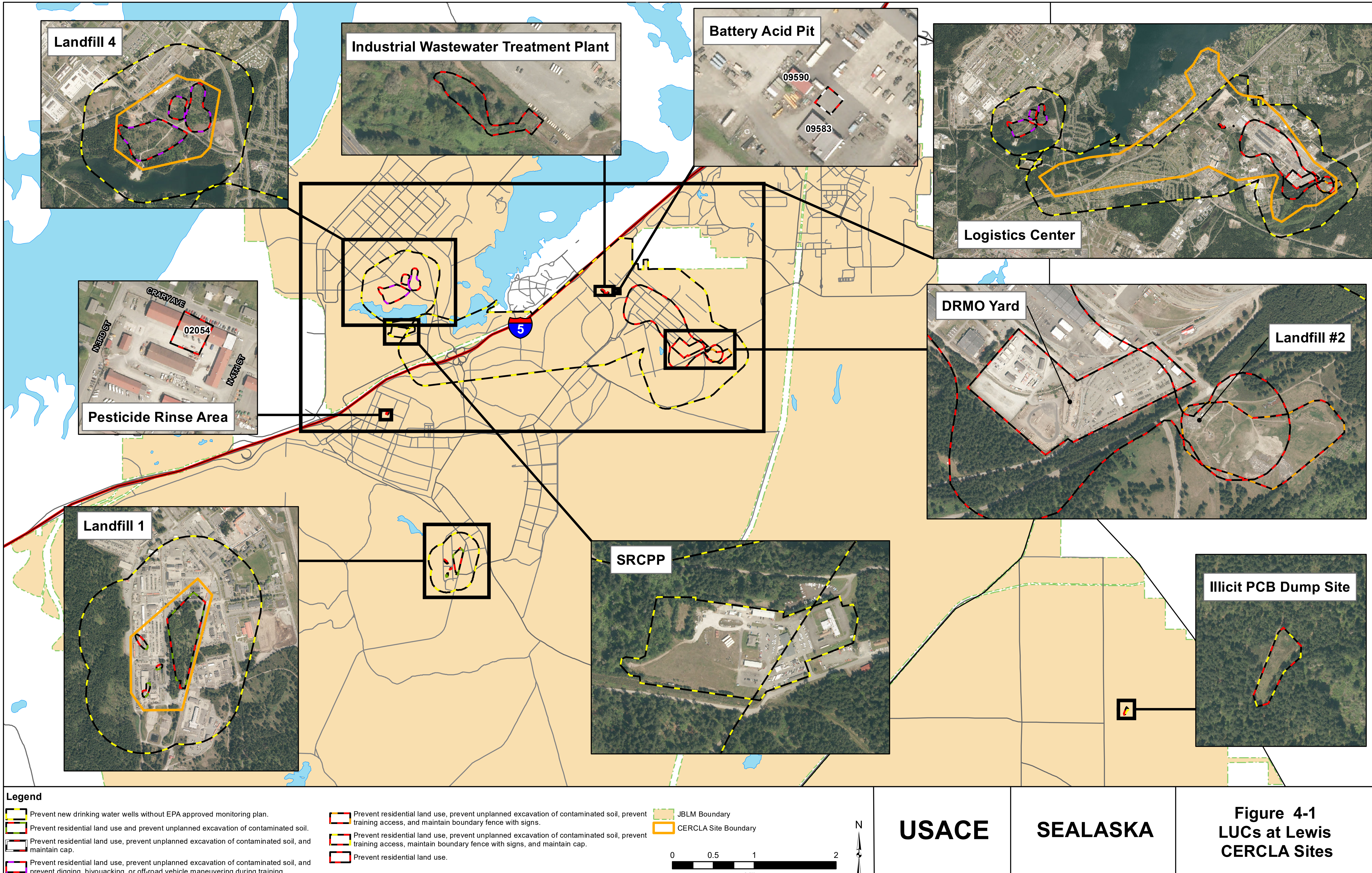
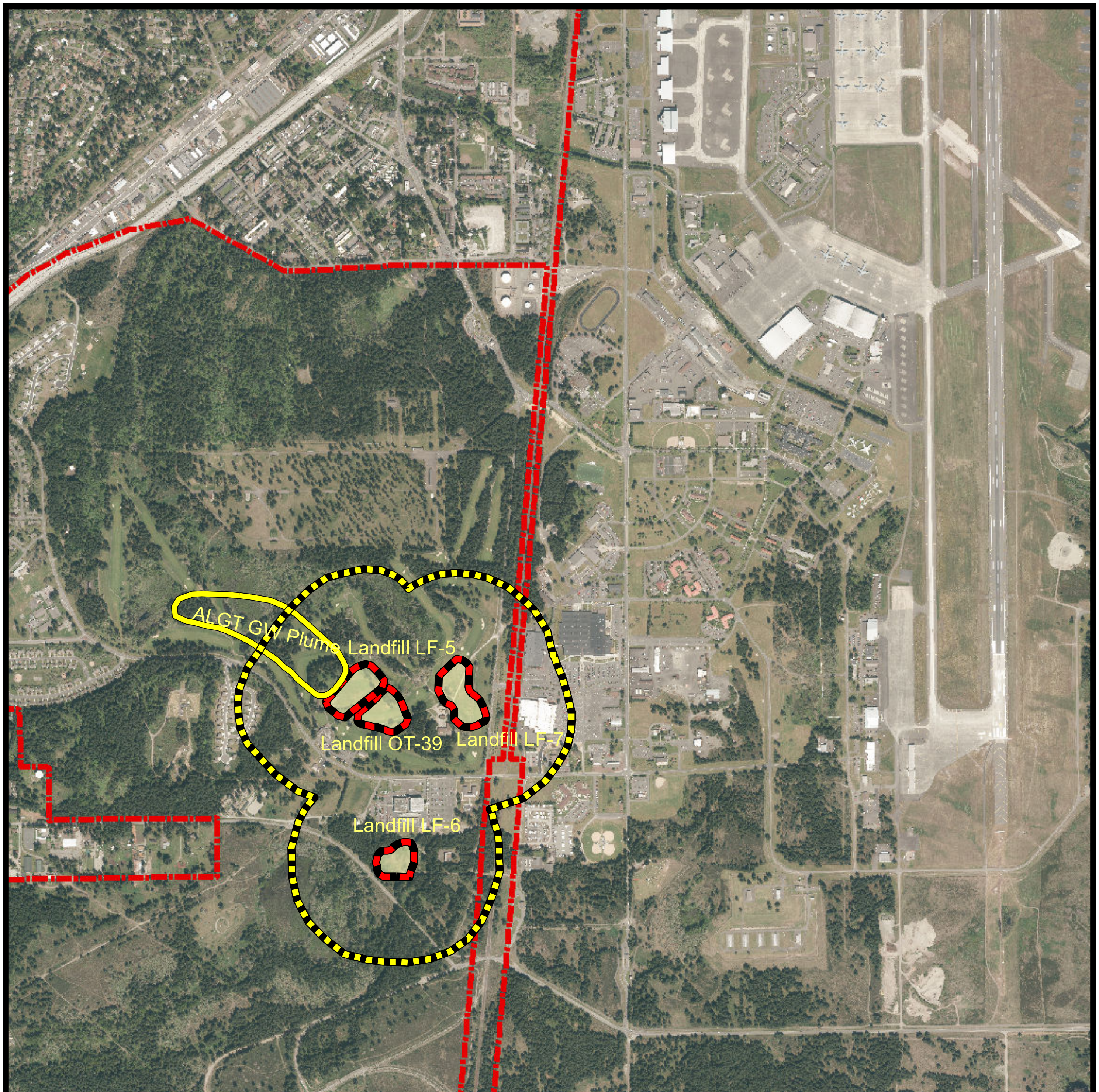


Figure 3-2 - Water Districts Near JBLM



Path: P:\Dropbox (SES)\Fig\JBLM\TO 01A\LUC Plan\MXD\LUC_Plan_Fig_3-1_LUCs.mxd
Date: 8/16/2016



Prevent new water wells within 1000 ft w/o State approval

Prevent New Water Supply Wells

Prevent residential use, unauthorized excavations

Landfill Area

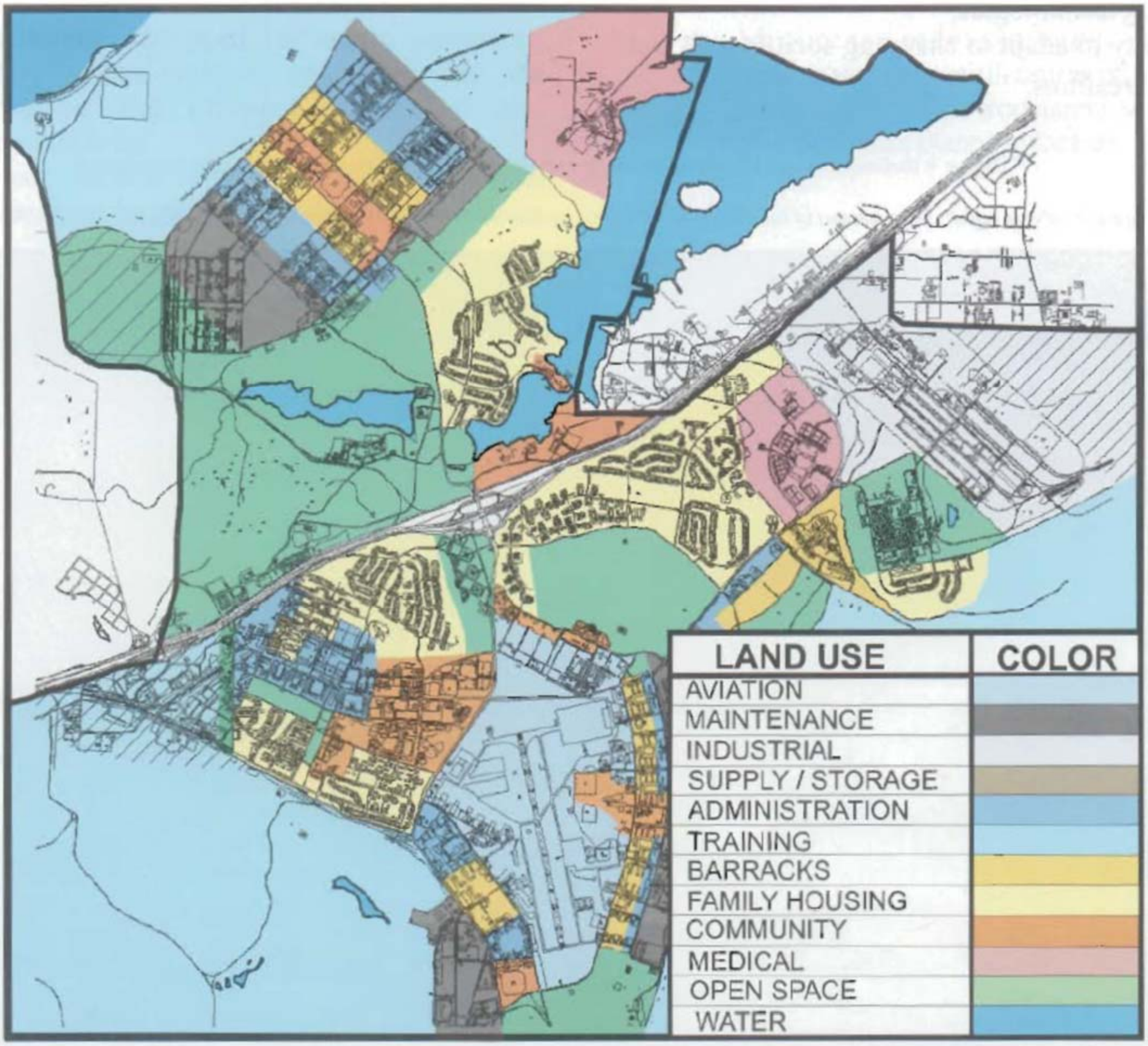
Figure 4-2 McChord Field
CERCLA LAND USE CONTROLS

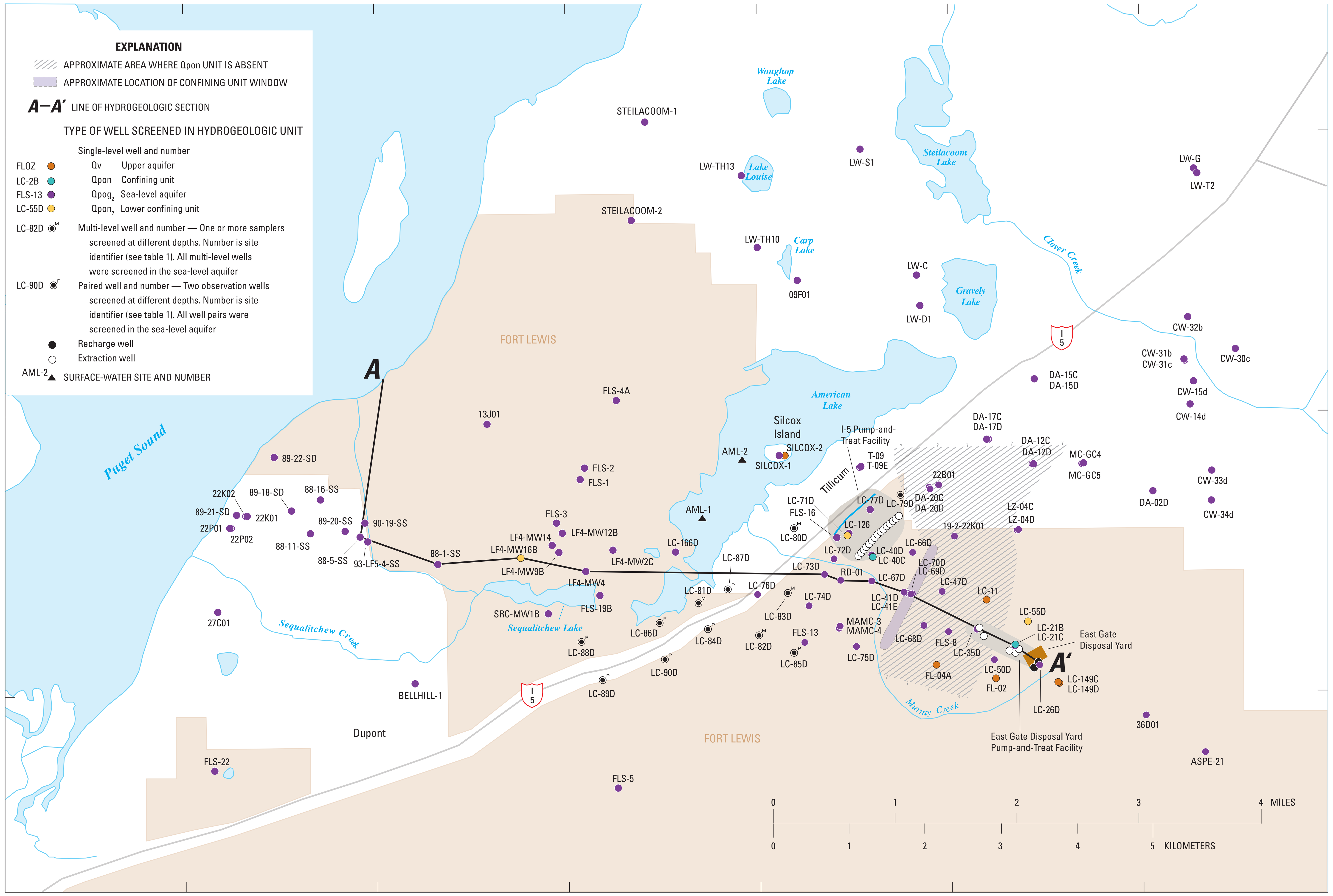
0 750 1,500 3,000 Feet

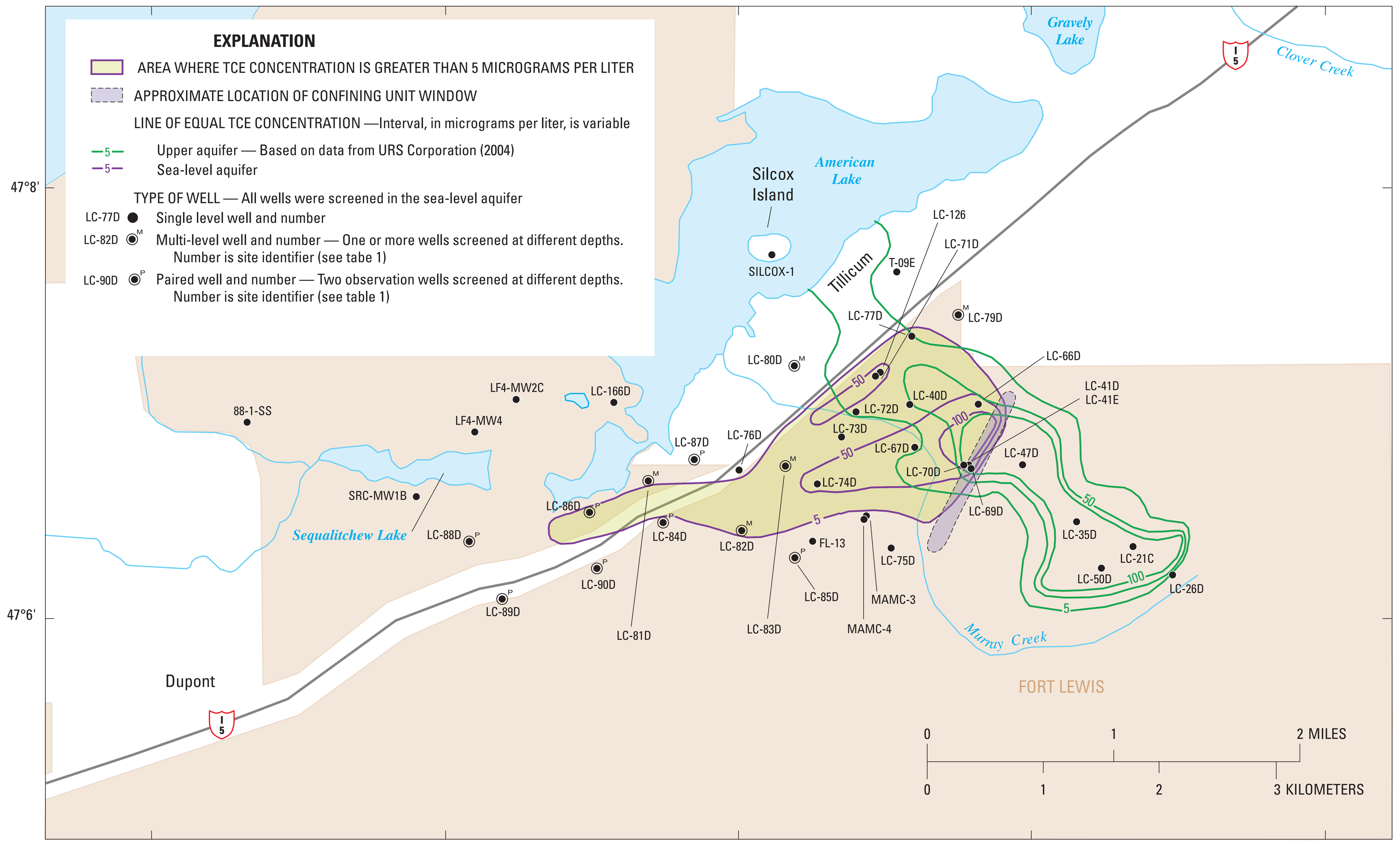
N

Figure 4-3: Fort Lewis Land Use Plan from Fort Lewis Real Property Master Plan Brochure

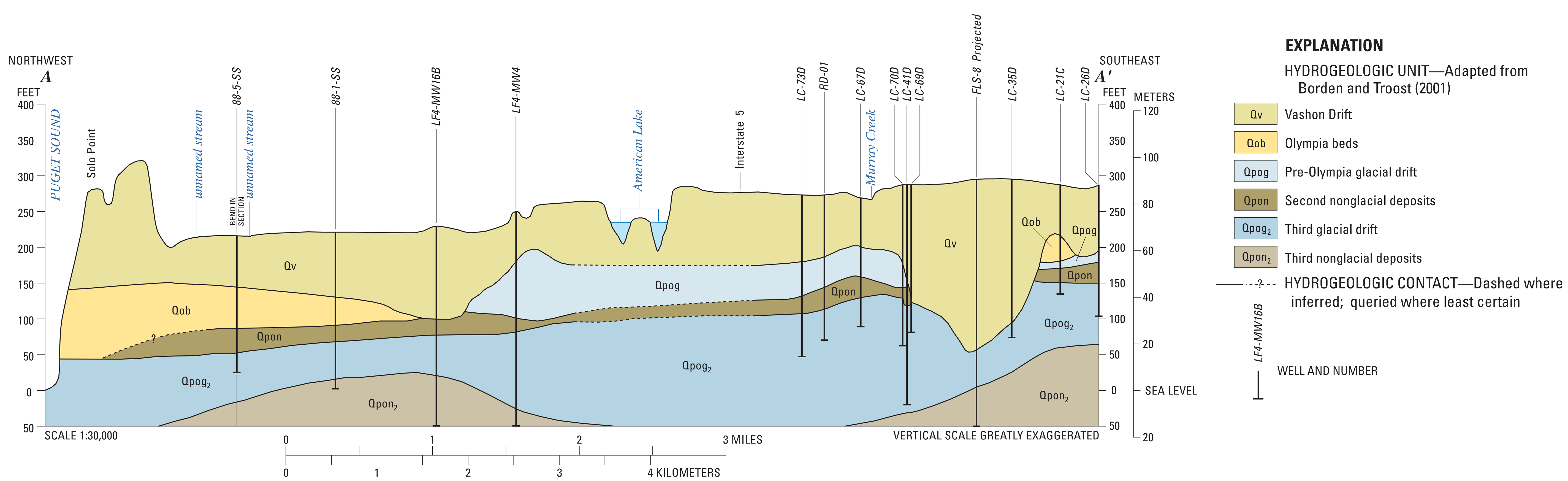
Figure 10 (below): Fort Lewis Land Use Plan

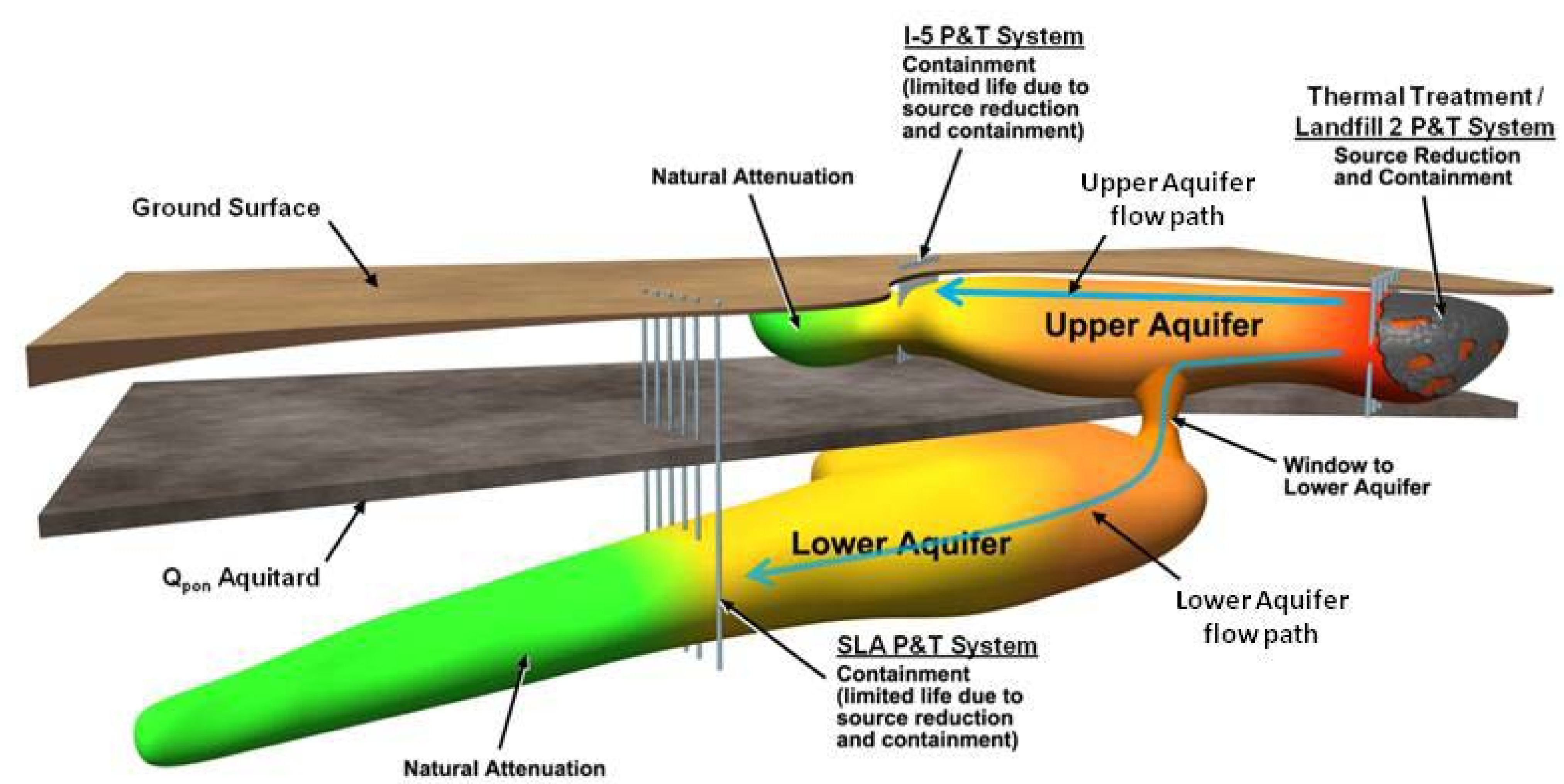






Well No.	Trichloroethene (micrograms per liter)	Well No.	Trichloroethene (micrograms per liter)	Well No.	Trichloroethene (micrograms per liter)	Well No.	Trichloroethene (micrograms per liter)	Well No.	Trichloroethene (micrograms per liter)	Well No.	Trichloroethene (micrograms per liter)
88-1-SS	<0.1	LC-50D	<0.2	LC-77D	10	LC-81D-4	<0.2	LC-85D-2	<1	LF4-MW2C	0.3
FLS-13	.6	LC-66D	55	LC-79D-1	<.2	LC-82D-1	6.4	LC-86D-1	6.8	LF4-MW4	<.1
LC-126	67	LC-67D	53	LC-79D-2	<.2	LC-82D-3	.4	LC-86D-2	5.7	MAMC-3	2.6
LC-166D	<.1	LC-69D	160	LC-79D-3	<.2	LC-82D-4	2.3	LC-87D-1	<1	MAMC-4	<.1
LC-21C	<.1	LC-70D	.4	LC-79D-4	<.2	LC-83D-1	44	LC-87D-2	<1	SILCOX-1	<.1
LC-26D	<.1	LC-71D	<.1	LC-80D-1	<.2	LC-83D-2	15	LC-88D-1	1.7	SRC-MW1B	<.1
LC-35D	<.1	LC-72D	24	LC-80D-2	<.2	LC-83D-3	11	LC-88D-2	1.3	T-09E	1.1
LC-40D	19	LC-73D	37	LC-80D-3	<.2	LC-83D-4	.8	LC-89D-1	<1		
LC-41D	170	LC-74D	61	LC-81D-1	3.9	LC-84D-1	3.1	LC-89D-2	<1		
LC-41E	<1	LC-75D	.8	LC-81D-2	4.8	LC-84D-2	1	LC-90D-1	2.1		
LC-47D	<.1	LC-76D	<.1	LC-81D-3	2.9	LC-85D-1	<1	LC-90D-2	<1		

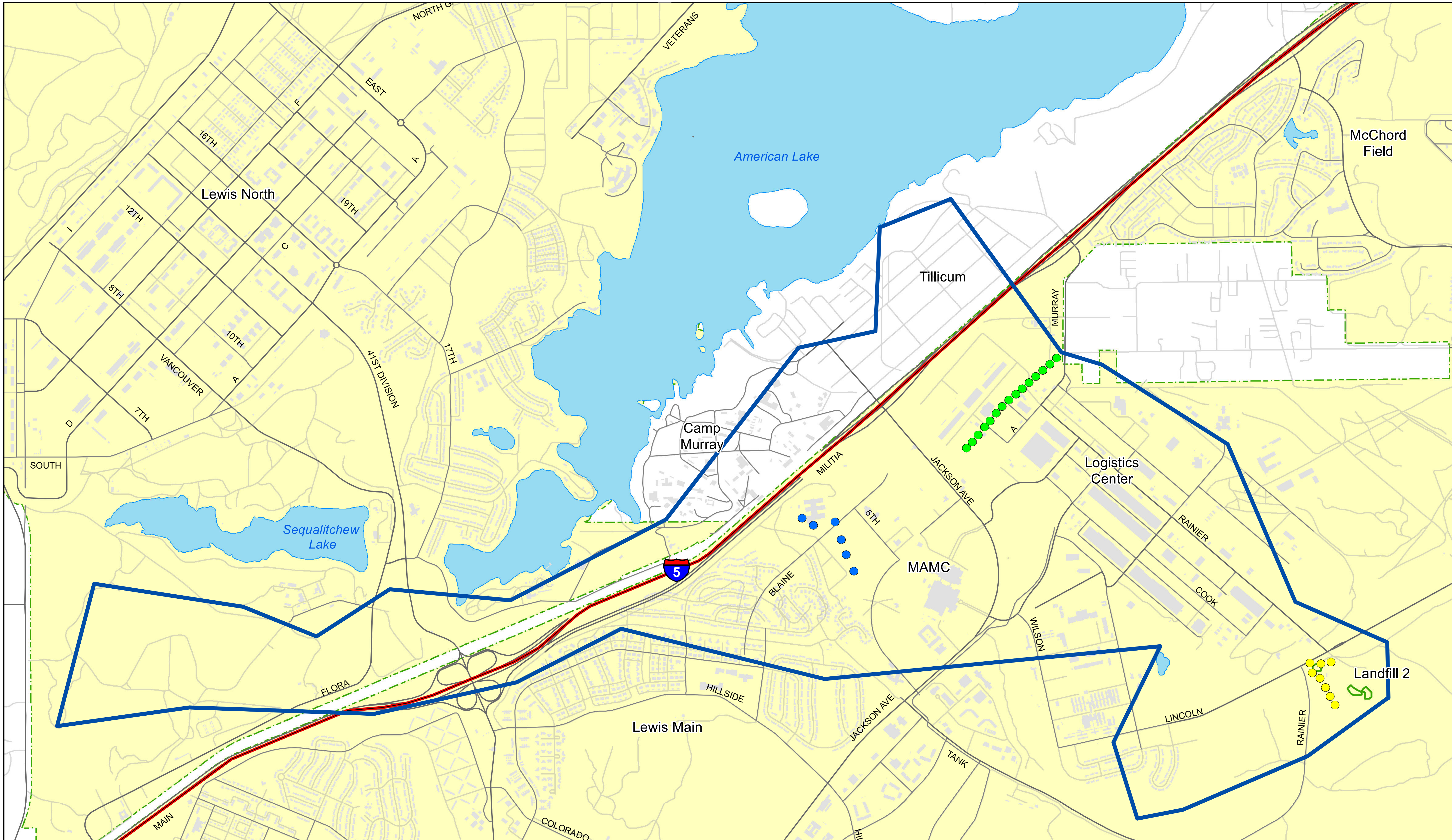




Base from U.S. Geological Survey digital data, 1:100,000, 1983
Universal Transverse Mercator projection, Zone 10, Datum NAD27

MAP SHOWING LOCATION OF DATA-COLLECTION SITES, HYDROGEOLOGIC SECTION, AND TCE CONTAMINATION, FORT LEWIS, WASHINGTON
By
R.S. Dinicola
2005

Figure 4-4 - Depiction of the Hydrogeological Window Connecting the Upper and Lower Aquifers



Legend

- SLA P&T System Wells
- I-5 P&T System Wells
- Landfill 2 P&T System Wells
- Project Area
- Landfill 2 NAPL Areas
- JBLM Boundary

N

0 0.15 0.3 0.6
Miles
1 inch = 1,750 feet

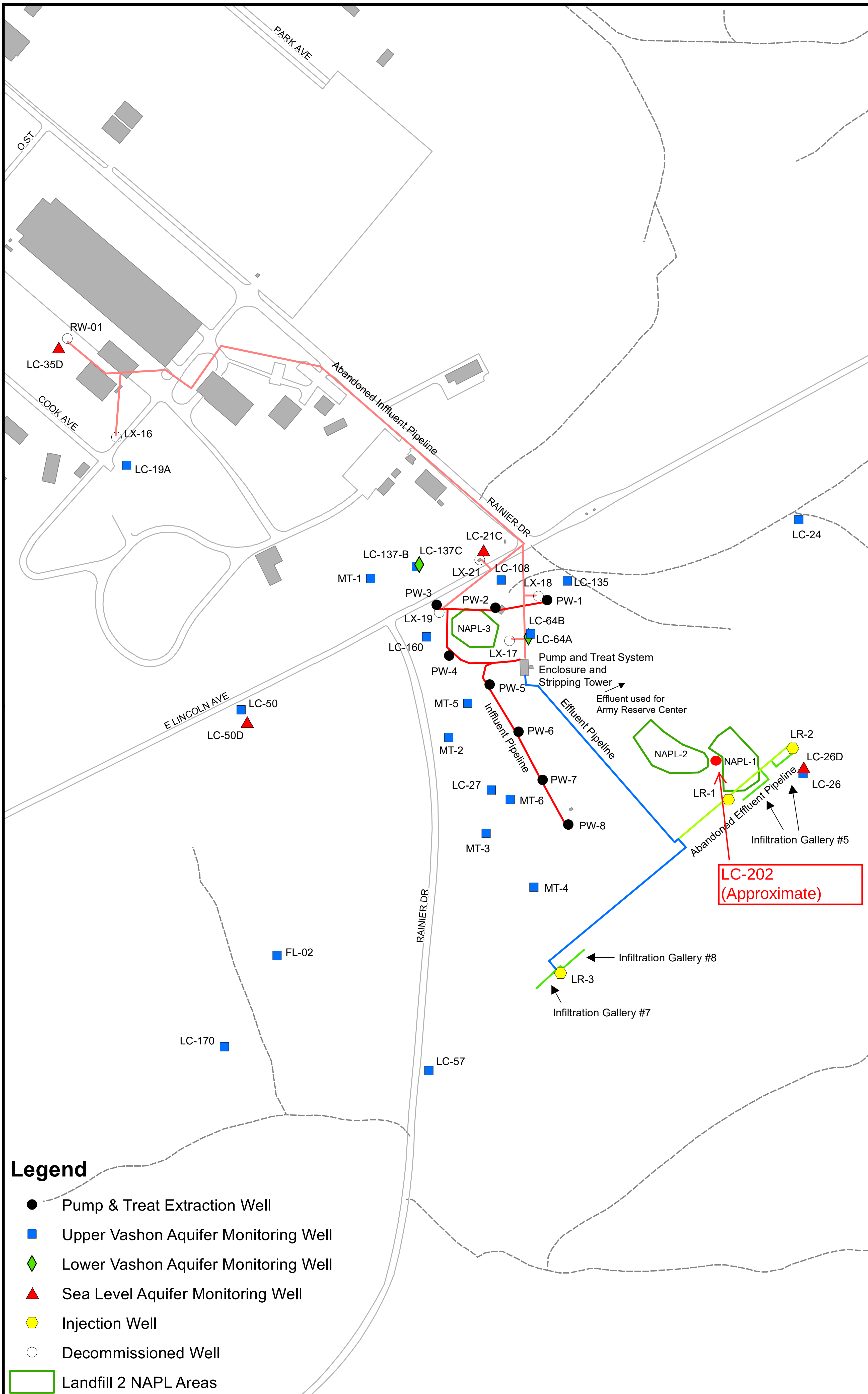
MAP DATA:
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

USACE

SEALASKA

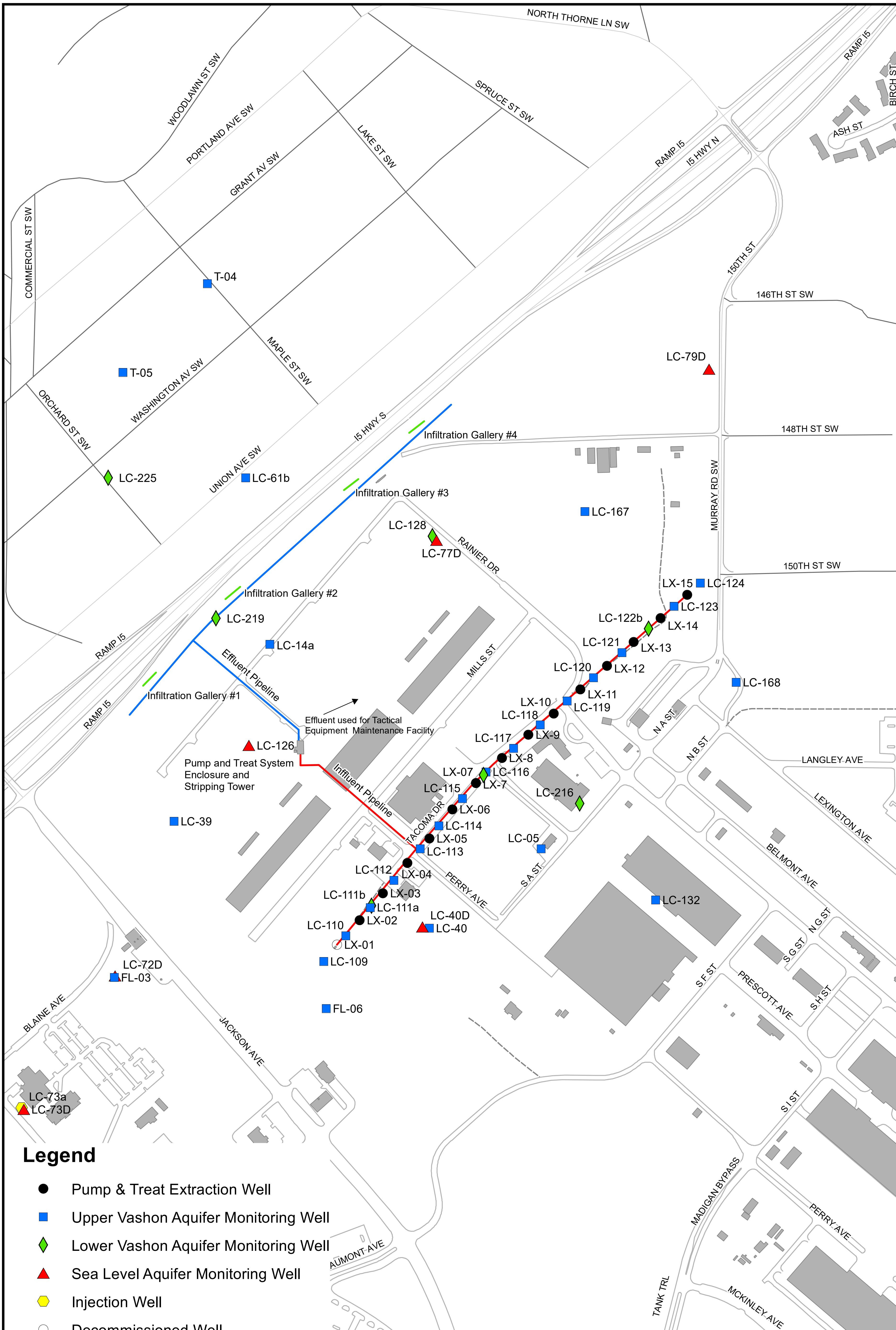
Figure 5-1
Logistics Center
Project Location Map

Path: P:\Production\Fig\JBLM\TO 001\Logistics Center\LOGRAM_O&M_AR\LOGRAM_OMAR-FIG_1-2_Proj_Loc.mxd
Date: 5/11/2015



Label ID MT-3 - Well ID 0 65 130 260 390 520 Feet N 1 inch = 350 feet	**MAP DATA:** COORDINATE SYSTEM: UTM, Zone 10 HORIZONTAL DATUM: WGS 84	**USACE**	**SEALASKA**	**Figure 5-2** **Landfill 2** **Pump and Treat System**

Path: P:\Production\Fig\JBLM\TO 001\Logistics Center\LOGRAM_O&M_AR\LOGRAM_OMAR-FIG_1-4_LF2P&T.mxd
Date: 7/30/2015



Label ID
LC-39 - Well ID

0 87.5 175 350 525 700 Feet

1 inch = 450 feet

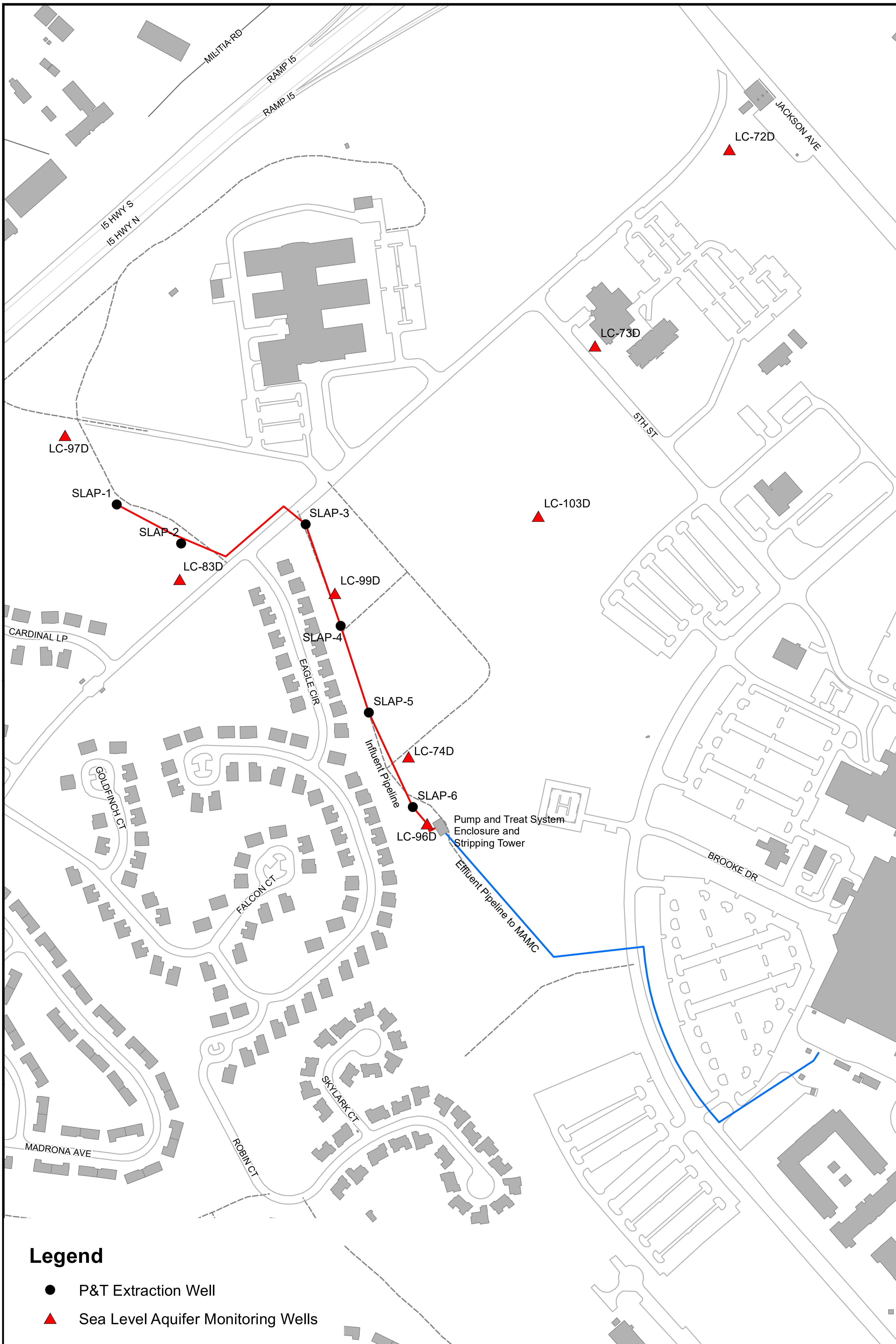
N

MAP DATA:
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

USACE **SEALASKA**

Figure 5-3
I-5 Pump and Treat System

Path: P:\Production\Fig\JBLM\TO 001\Logistics Center\LOGRAM_O&M_AR\LOGRAM_OMAR-FIG_1-3_I5P&T.mxd
Date: 7/30/2015



LC-39 - Well ID

0 62.5 125 250 375 500 Feet

1 inch = 310 feet

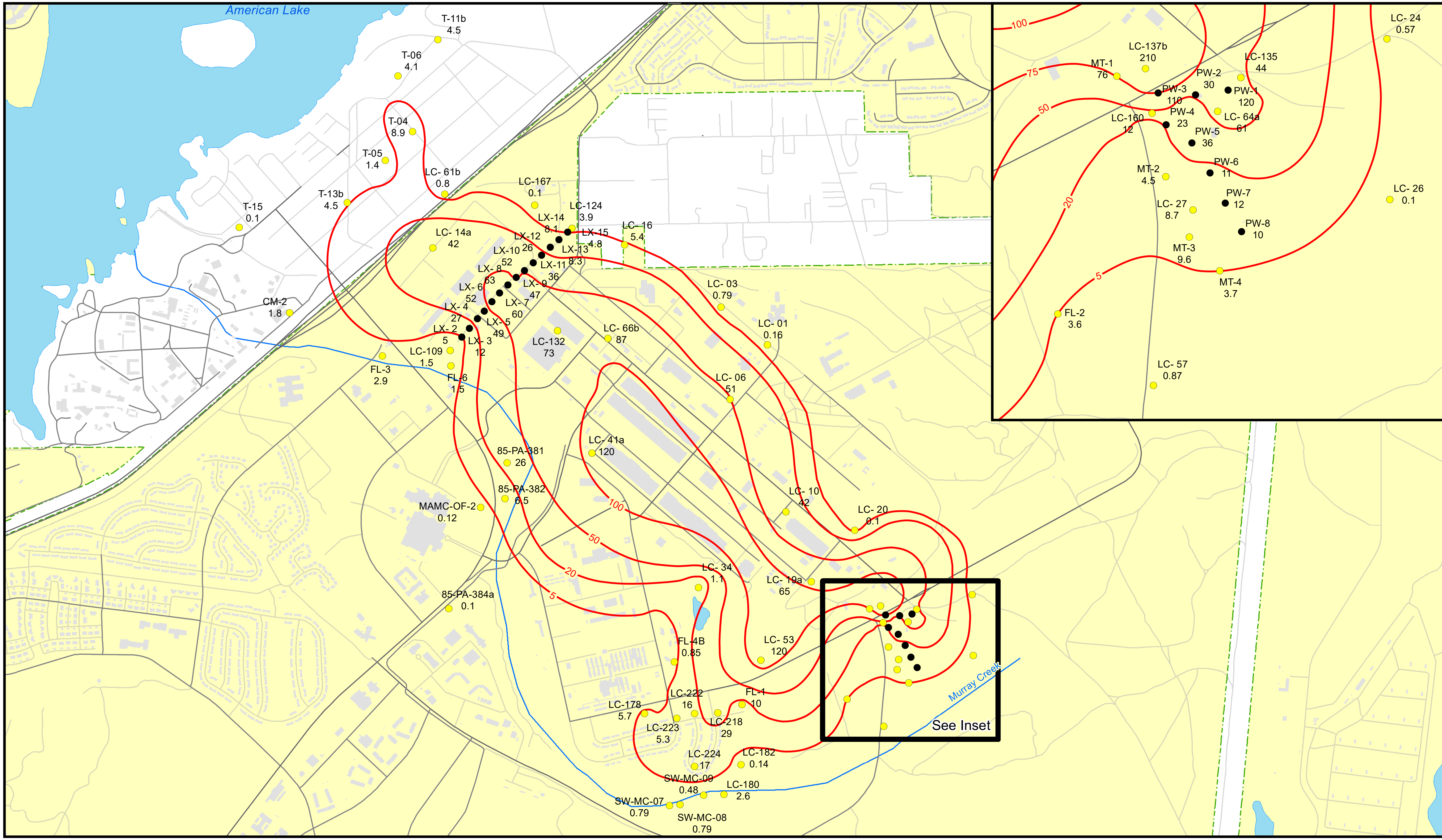
N

MAP DATA:
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

USACE | **SEALASKA**

Figure 5-4
Sea Level Aquifer
Pump and Treat System

Path: P:\Production\Fig\JBLM\TO 001\Logistics Center\LOGRAM_O&M_AR\LOGRAM_OMAR-FIG_1-5_SLAPT.mxd
Date: 8/17/2015



Legend

- Monitoring Well
- P&T System Extraction Well
- TCE Concentration

Label ID
LC-34 - Well ID
1.1 - TCE (µg/L)

N

0 625 1,250 2,500
Feet
1 inch = 1,375 feet

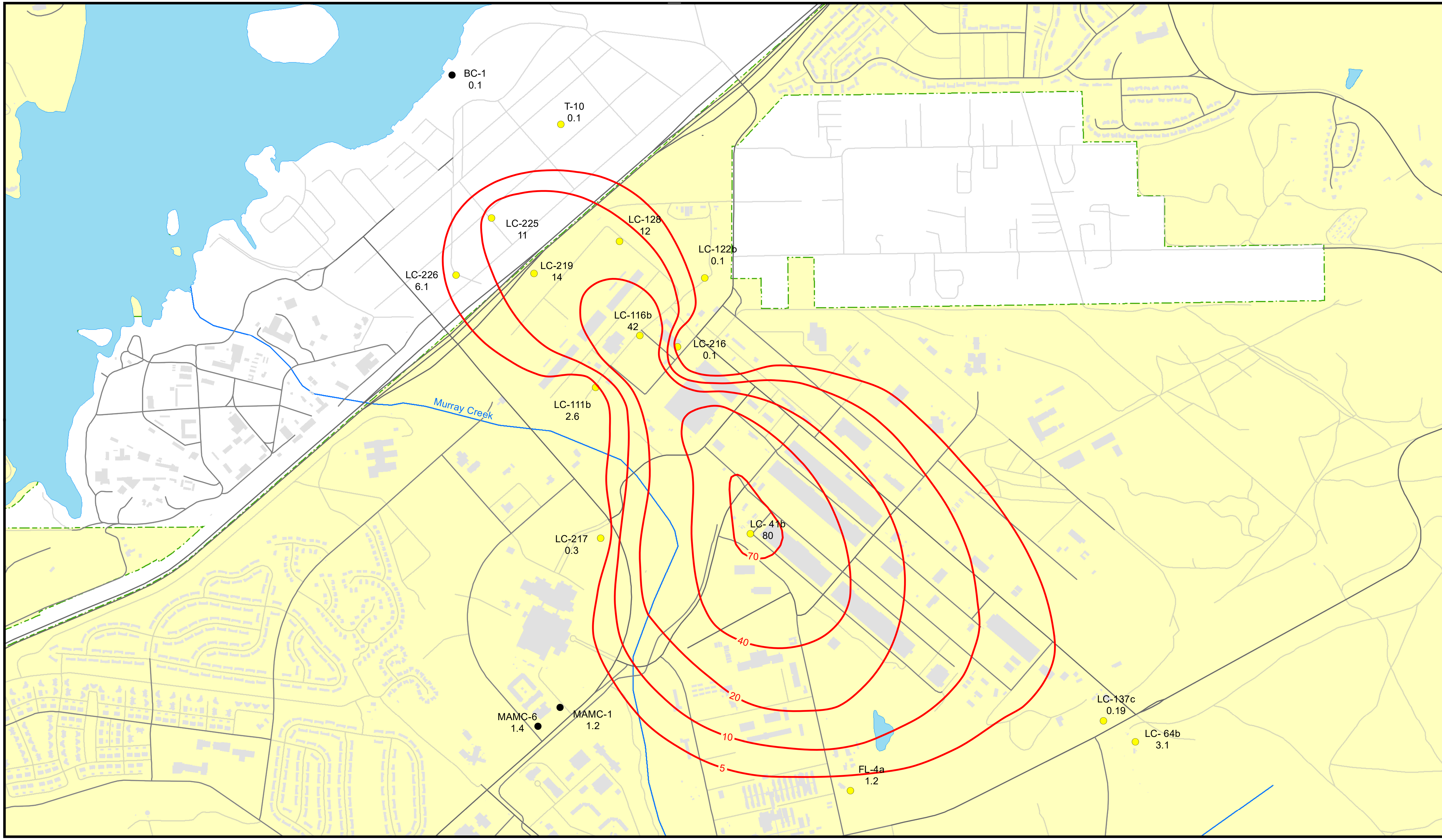
MAP DATA:
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

USACE

SEALASKA ENVIRONMENTAL

Figure 5-5
Upper Vashon Aquifer
TCE Plume 2015

Path: E:\JBLM\TO 01A\Logistics Center\LogRAM_2015_Annual_Report\MXD\LOGRAM_GWMRpt_2015-FIG_4-1_UVA_TCE.mxd
Date: 2/17/2016



Legend
- Monitoring Well
- Production Well
- TCE Concentration

Label ID
LC-34 - Well ID
1.1 - TCE (µg/L)

N

0 500 1,000 2,000
Feet
1 inch = 1,125 feet

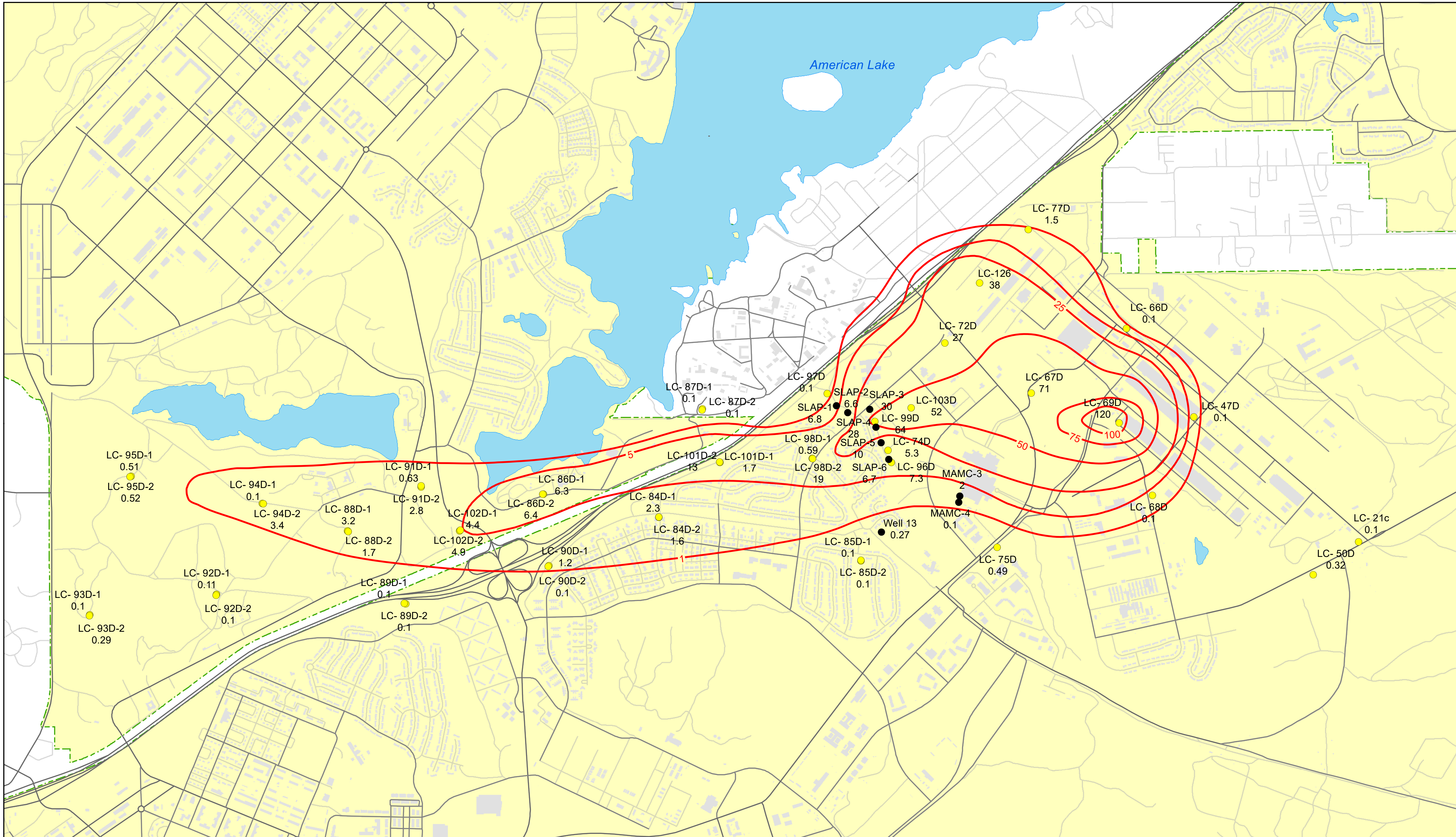
MAP DATA:
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

USACE

SEALASKA ENVIRONMENTAL

Figure 5-6
Lower Vashon Aquifer
TCE Plume 2015

Path: E:\JBLM\TO 01A\Logistics Center\LogRAM_2015_Annual_Report\MXD\LOGRAM_GWMRpt_2015-FIG_4-2_LVA_TCE.mxd
Date: 2/11/2016



Legend

Monitoring Well
Production Well
TCE Concentration

Label ID
LC-34 - Well ID
1.1 - TCE (µg/L)

N

0 750 1,500 3,000
Feet
1 inch = 1,725 feet

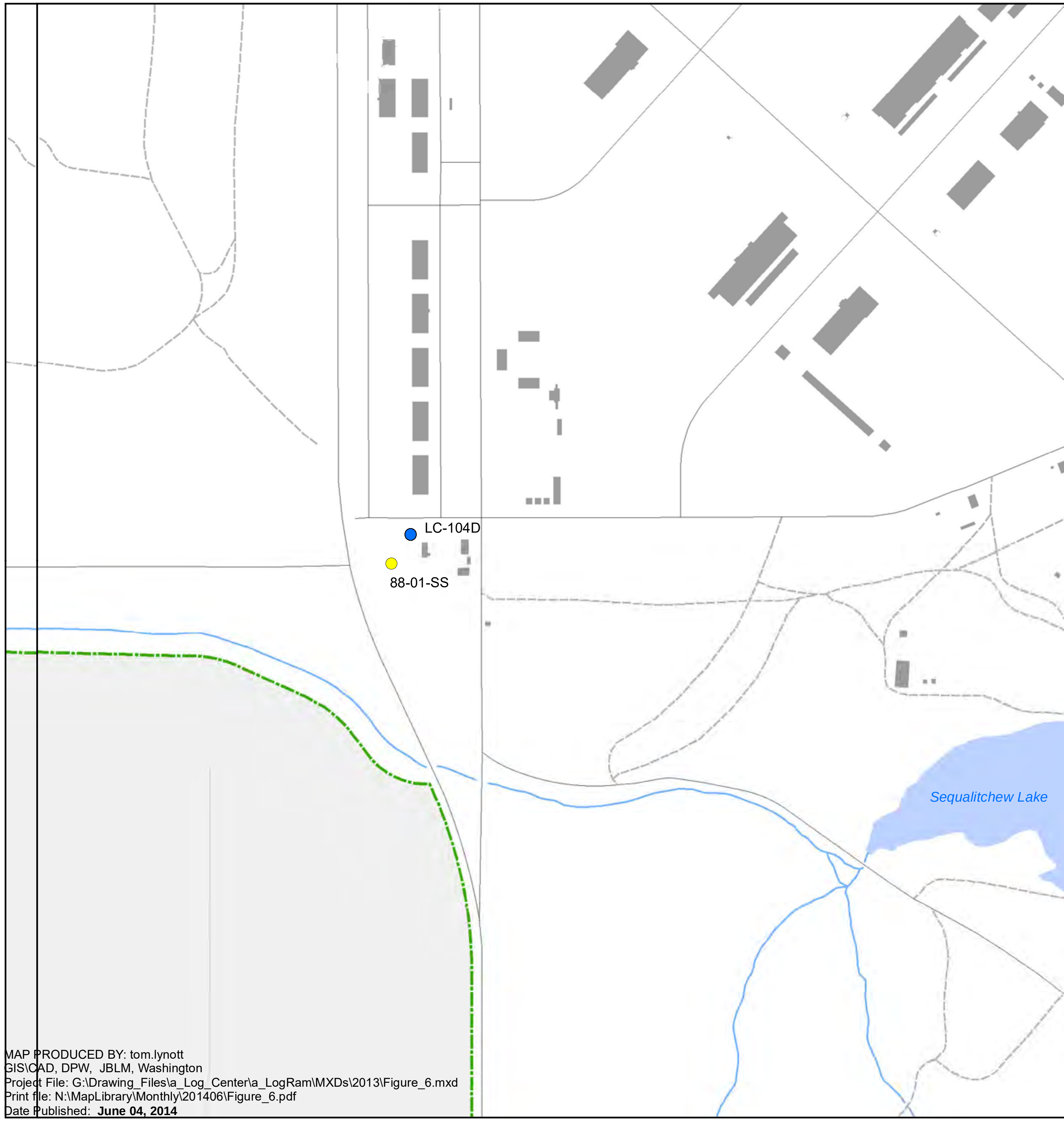
MAP DATA:
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

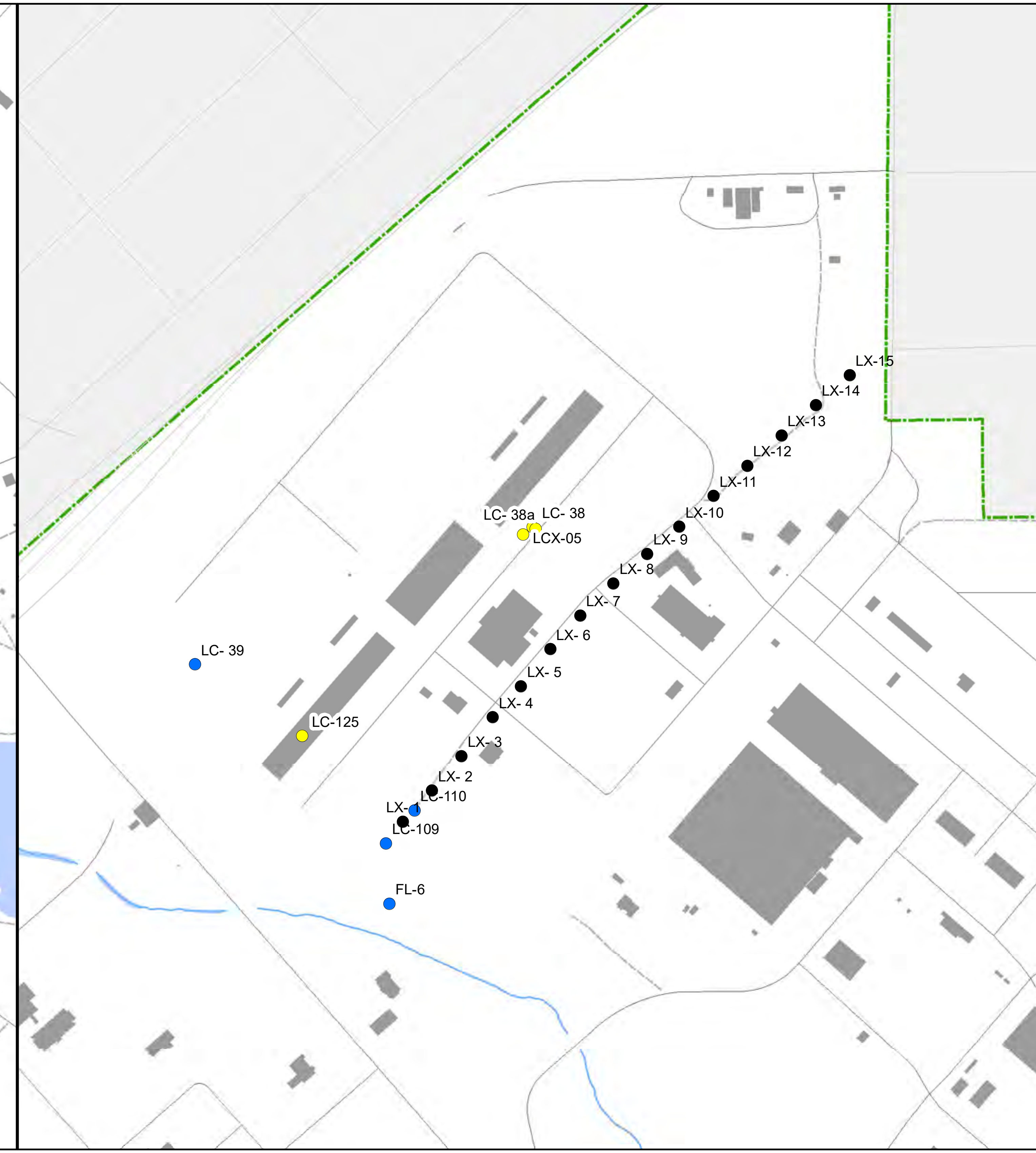
USACE

SEALASKA ENVIRONMENTAL

Figure 5-7
Sea Level Aquifer
TCE Plume 2015

Path: E:\JBLM\TO 01A\Logistics Center\LogRAM_2015_Annual_Report\MXD\LOGRAM_GWMRpt_2015-FIG_4-3_SLA_TCE.mxd
Date: 2/11/2016





Well Identification

Decommissioned Wells

Existing Monitoring Wells

Pump and Treat System Well

Label ID

LCX-05 - Well ID

N

West of Landfill 4
on Lewis North

1 inch = 500 feet

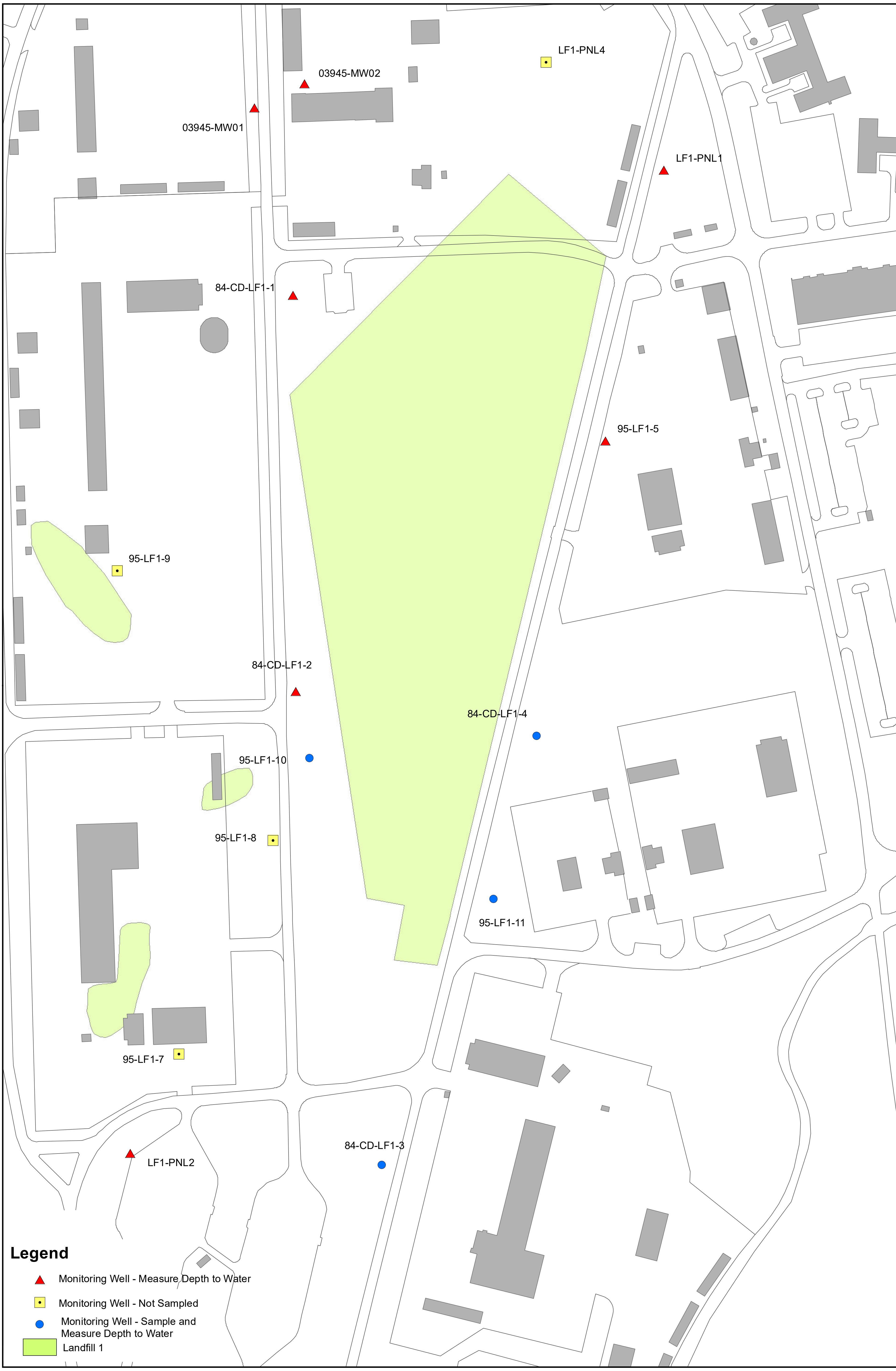
MAP DATA:
ELLIPSOID: GRS 80
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

North of I-5 Pump
and Treat System

DECOMMISSIONED
WELLS LOCATION
MAP
2013

Figure

5-8



MAP DATA:
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

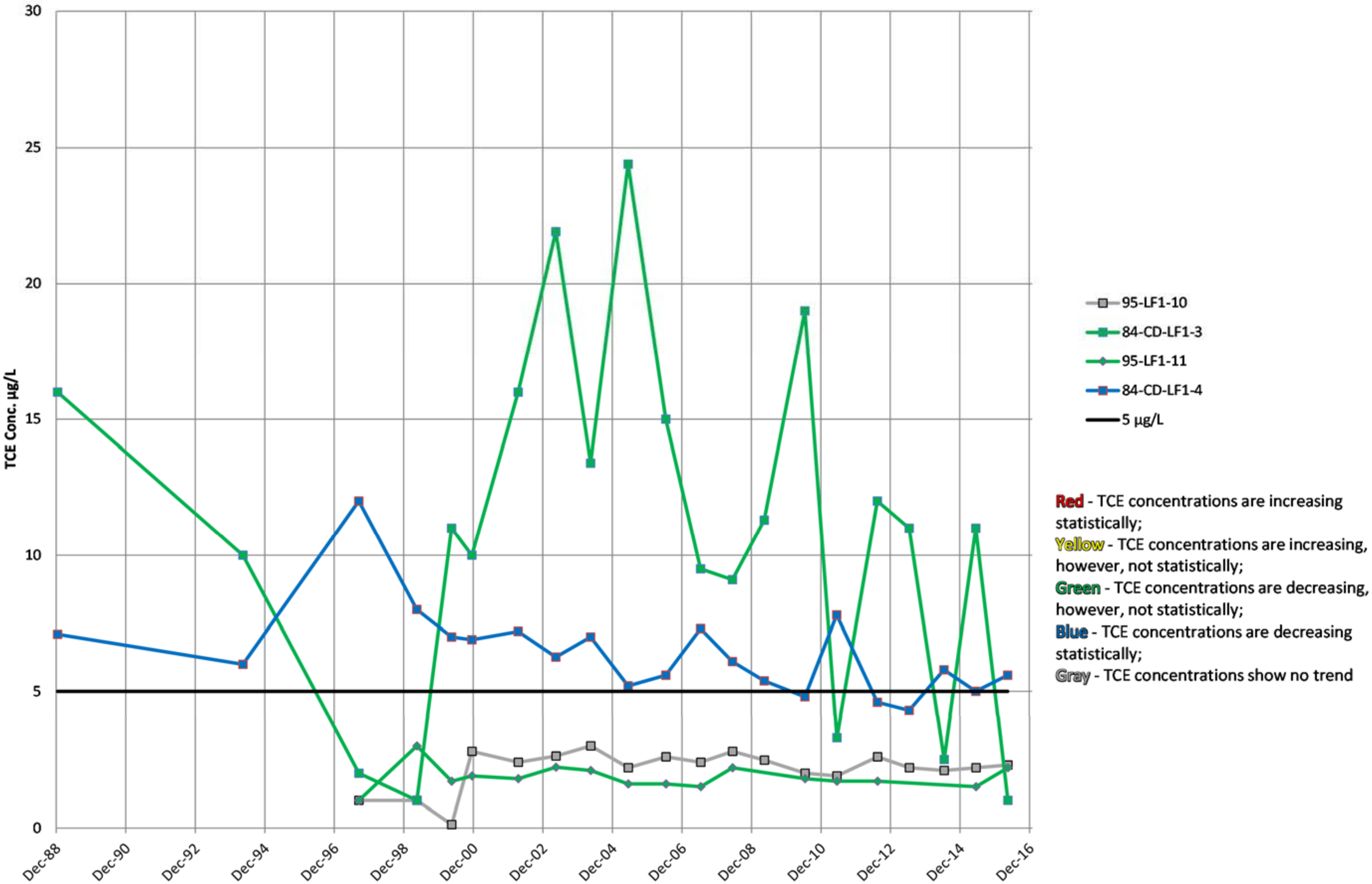
USACE

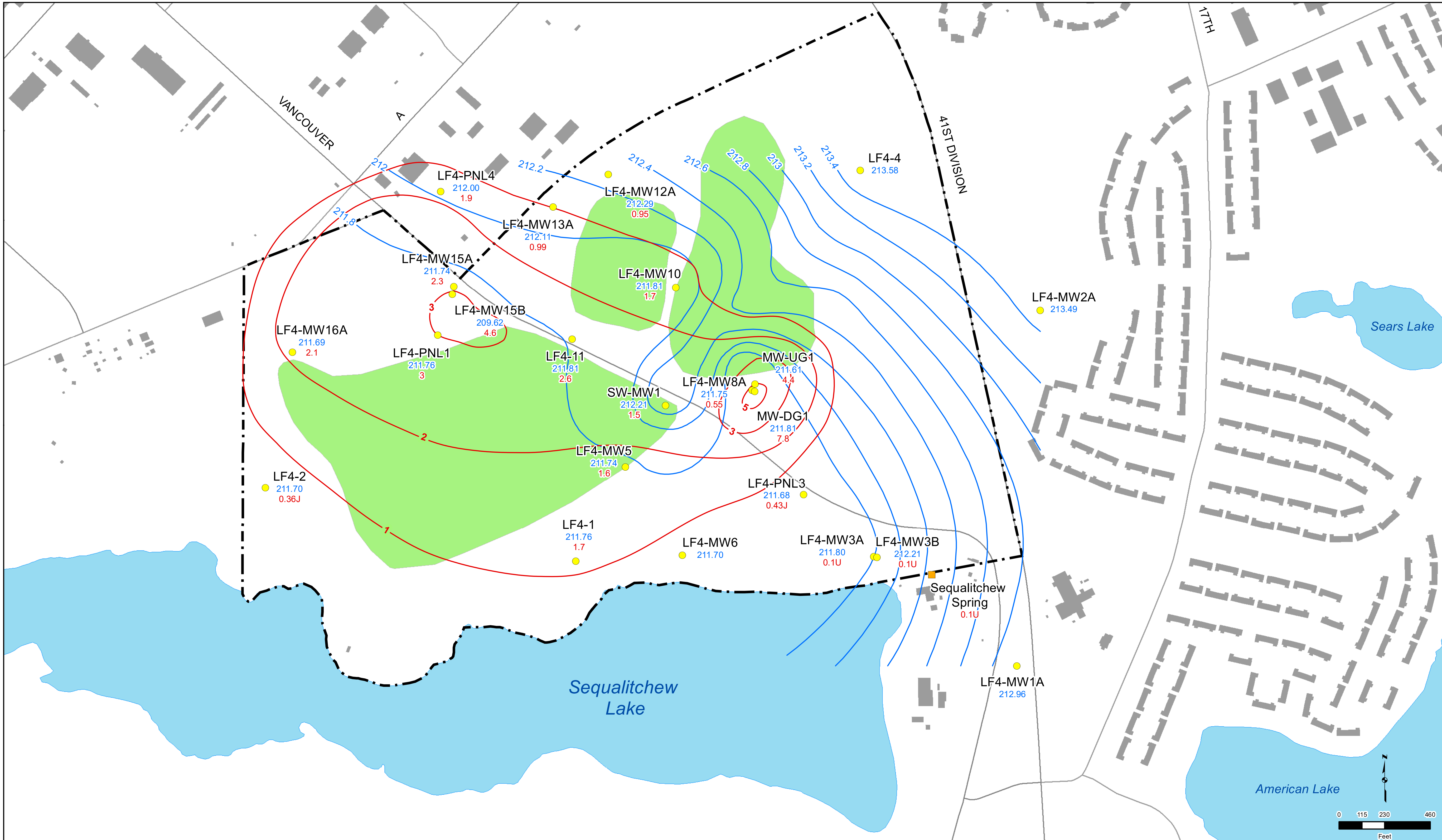
SEALASKA

Figure 5-9
Landfill 1 Proposed Monitoring Locations 2016

Path: H:\JBLM\MXD\LF1_FIG_2-1_MW.mxd
Date: 12/11/2014

Figure 5-10. TCE Concentrations Over Time





LF4 Monitoring Wells
Production Well
TCE Concentration (µg/L)
GW Elevation (ft/AMSL)
Landfill 4 Boundary
Landfill 4 Cell
211.81 Water Level (ft/AMSL)
7.8 TCE Concentration (µg/L)

Map Data:
Coordinate System: UTM, Zone 10
Horizontal Datum: WGS 84

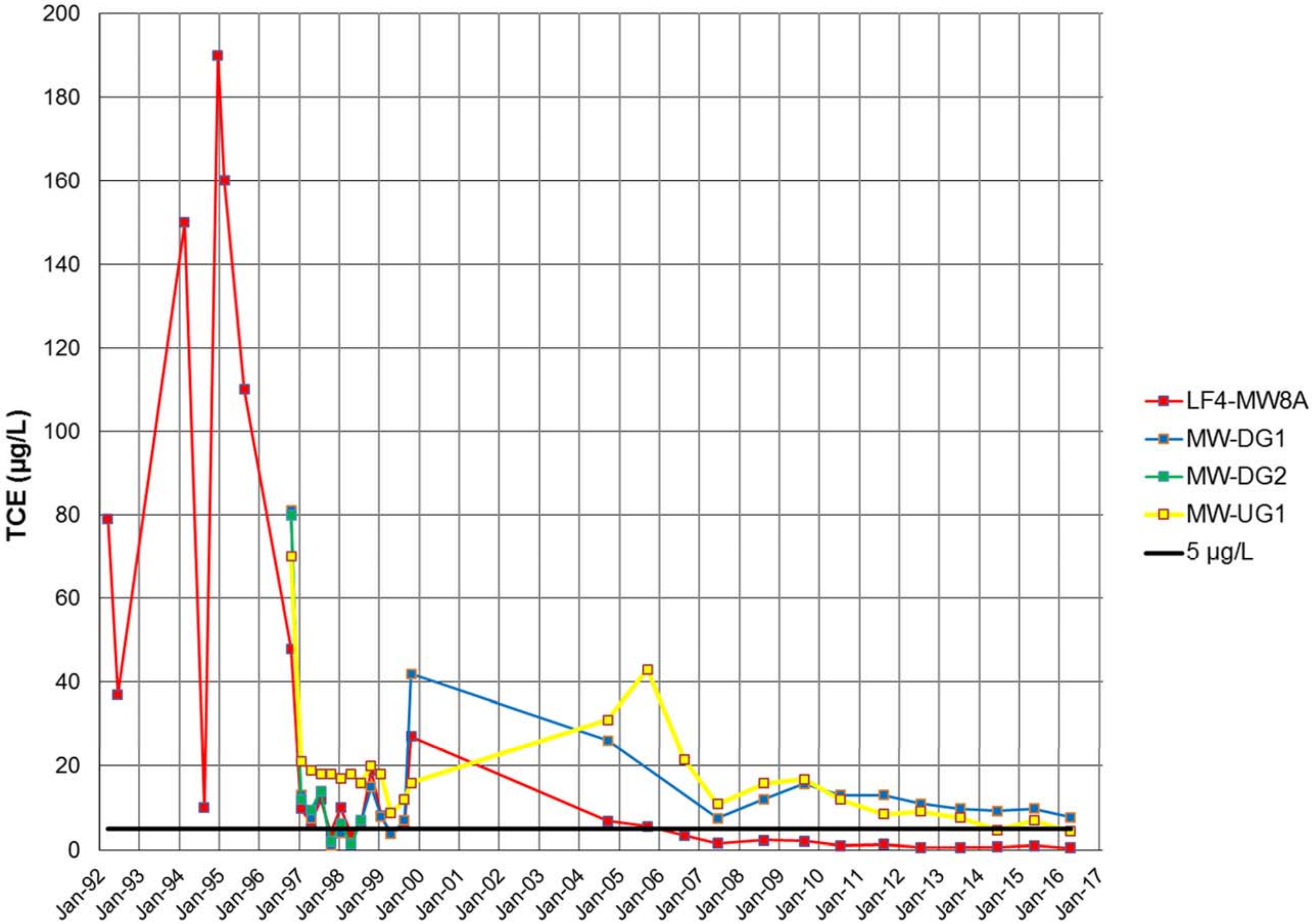
USACE

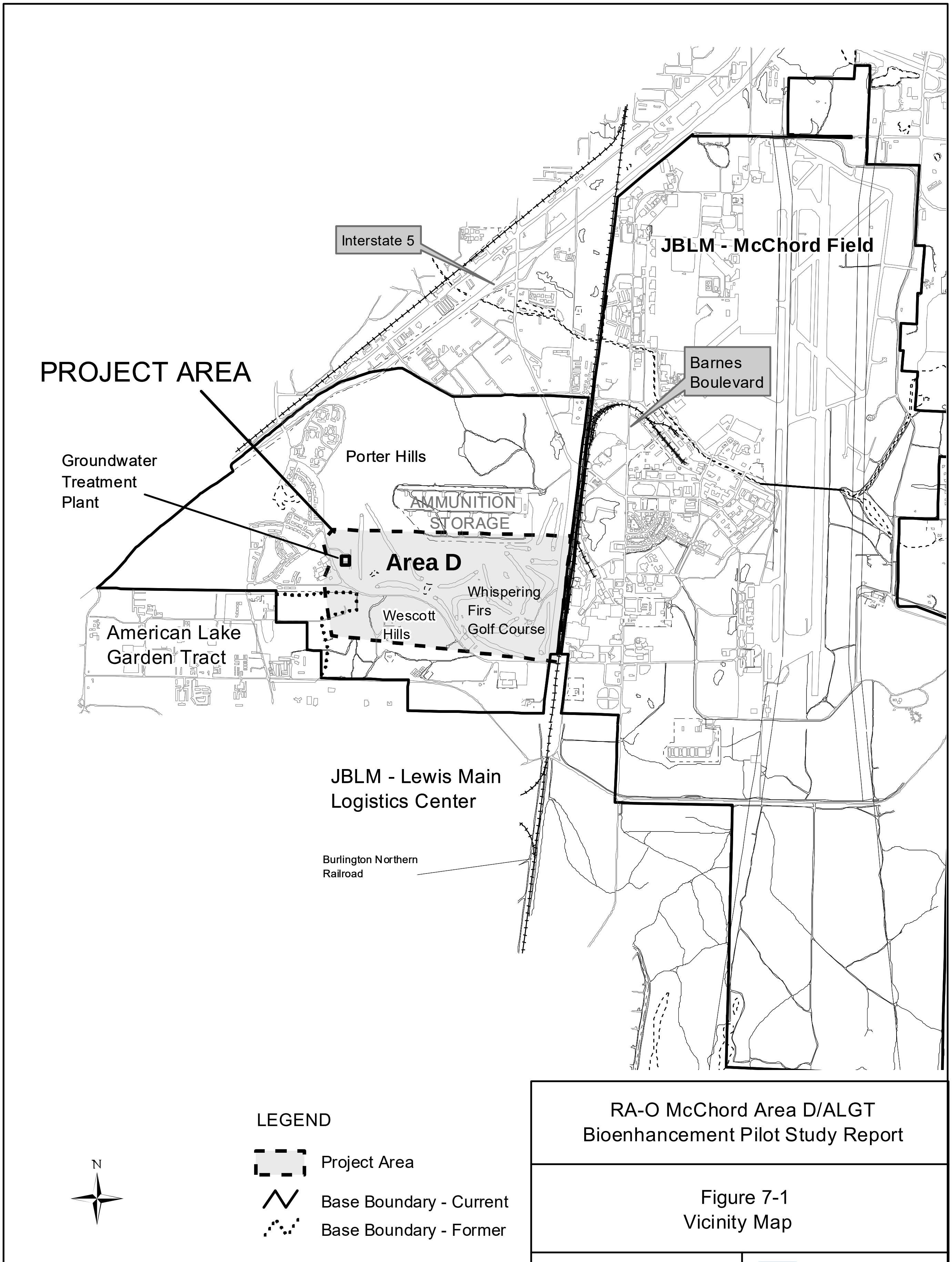
SEALASKA ENVIRONMENTAL

Figure 6-1
Landfill 4 Water Table and TCE Concentration Contours 2016

Path: E:\JBLM\TO 01A\LF4\LF4 Annual Report 2016\MXD\LF4_FIG_3-1_TCE_H2O.mxd
Date: 9/13/2016

Figure 6-2. TCE Concentrations over Time in Source Wells





LEGEND

Project Area

Base Boundary - Current

Base Boundary - Former

RA-O McChord Area D/ALGT
Bioenhancement Pilot Study Report

Figure 7-1
Vicinity Map

Date: 4/2011

TETRA TECH EC, INC.

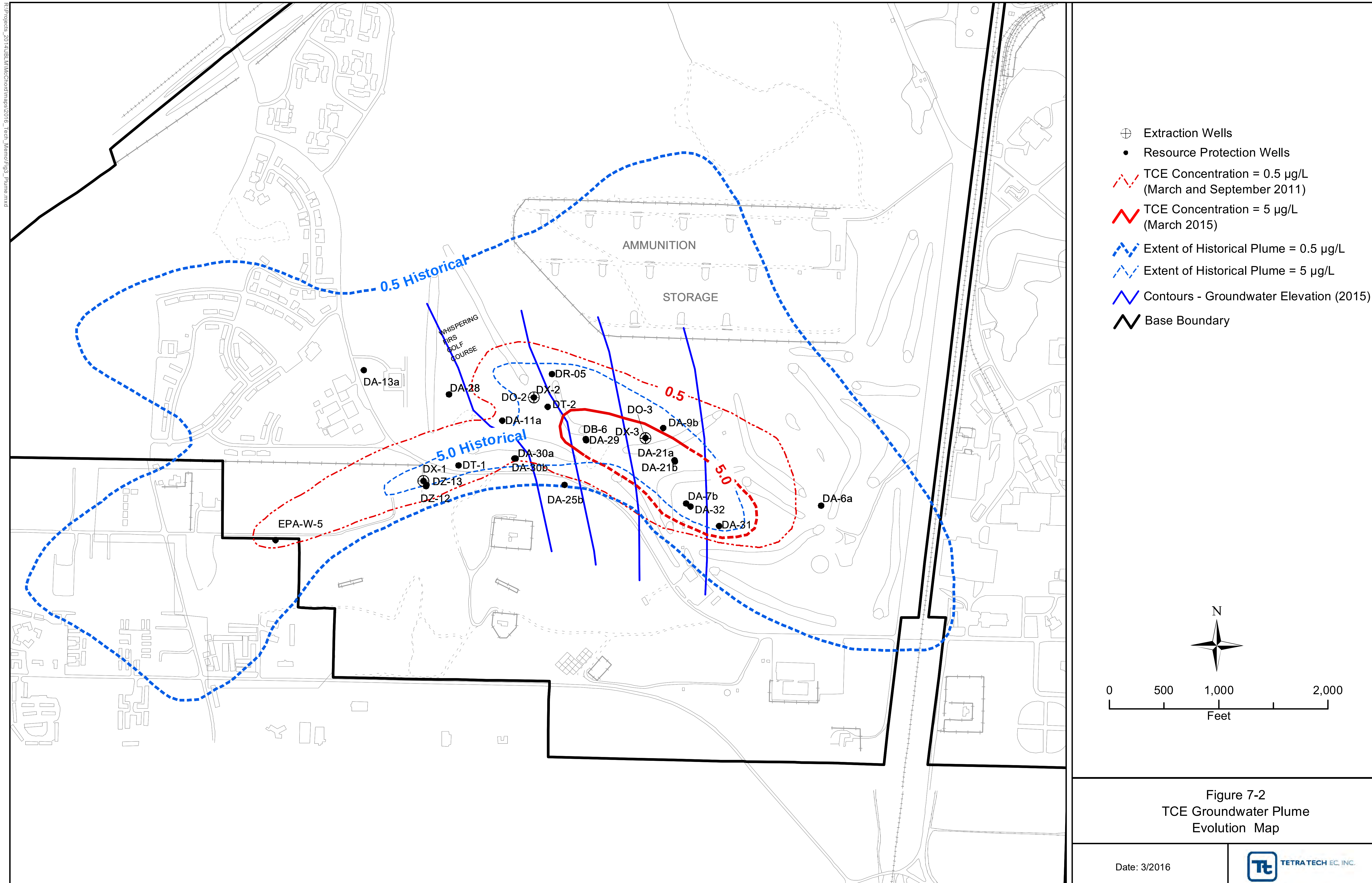


Figure 7-2
TCE Groundwater Plume
Evolution Map

Date: 3/2016

TETRA TECH EC, INC.

R:\Projects_2014\JBLMMcChord\maps\2015_Annual_Report_AreaD_ALGT\Fig2_AreaD_Location.mxd

Legend

System Extraction Well

2" Pipe

6" Main Pipe

Access Road

Parking

N

0 100 200 400

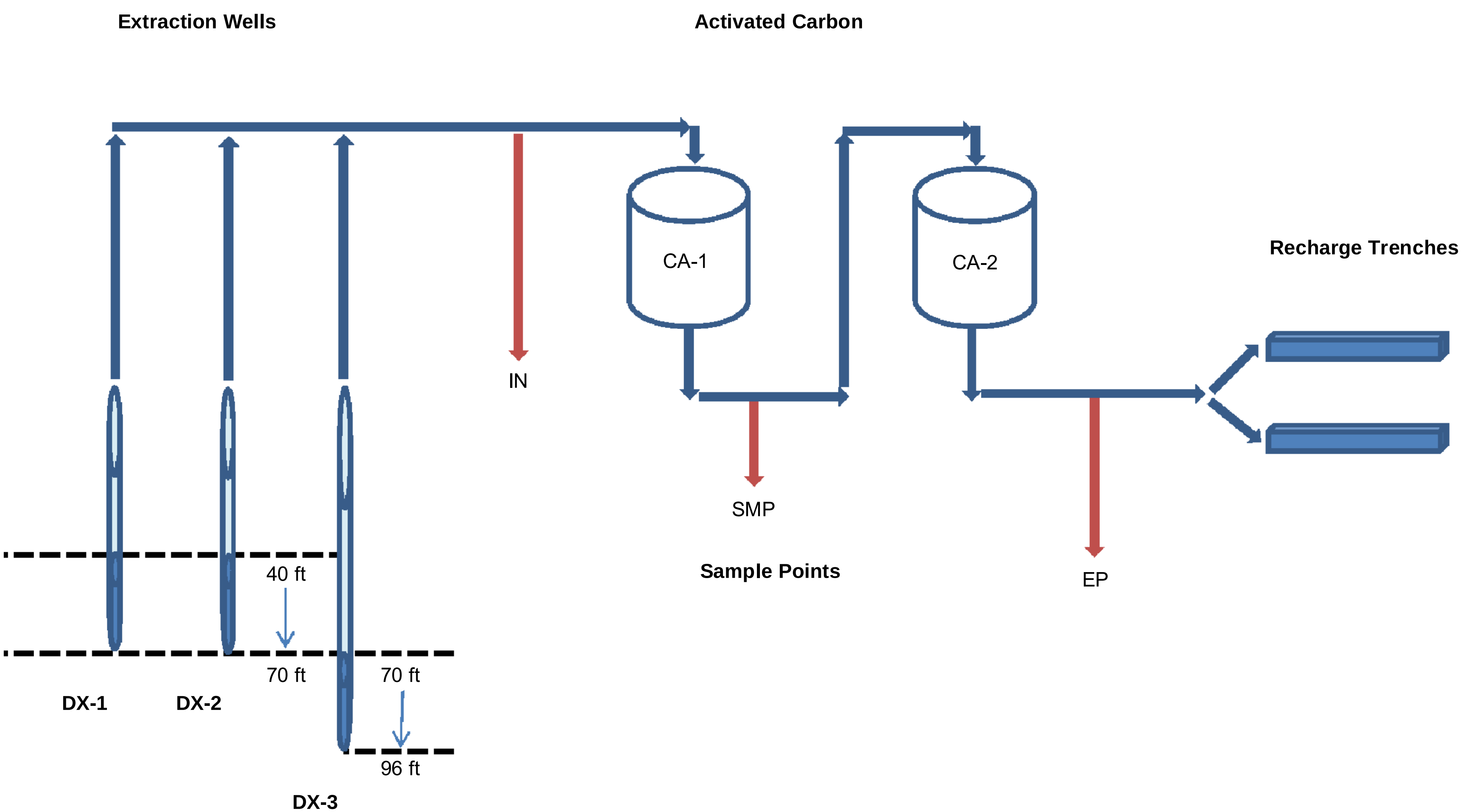
Feet

JBLM McChord Field
Area D/ALGT
2015 Annual Report

Figure 7-3a
Area D/ALGT GPT System Location Map

Date: 2/2016

TETRA TECH EC, INC.



R:\Projects_2014\JBLM\McChord\maps\2015_Annual_Report_AreaD_ALGT\Fig3_System_Diagram.mxd

Legend

Sample Locations

IN = Influent Point

SMP = System Monitoring Point

EP = Effluent Point

Screened interval depth

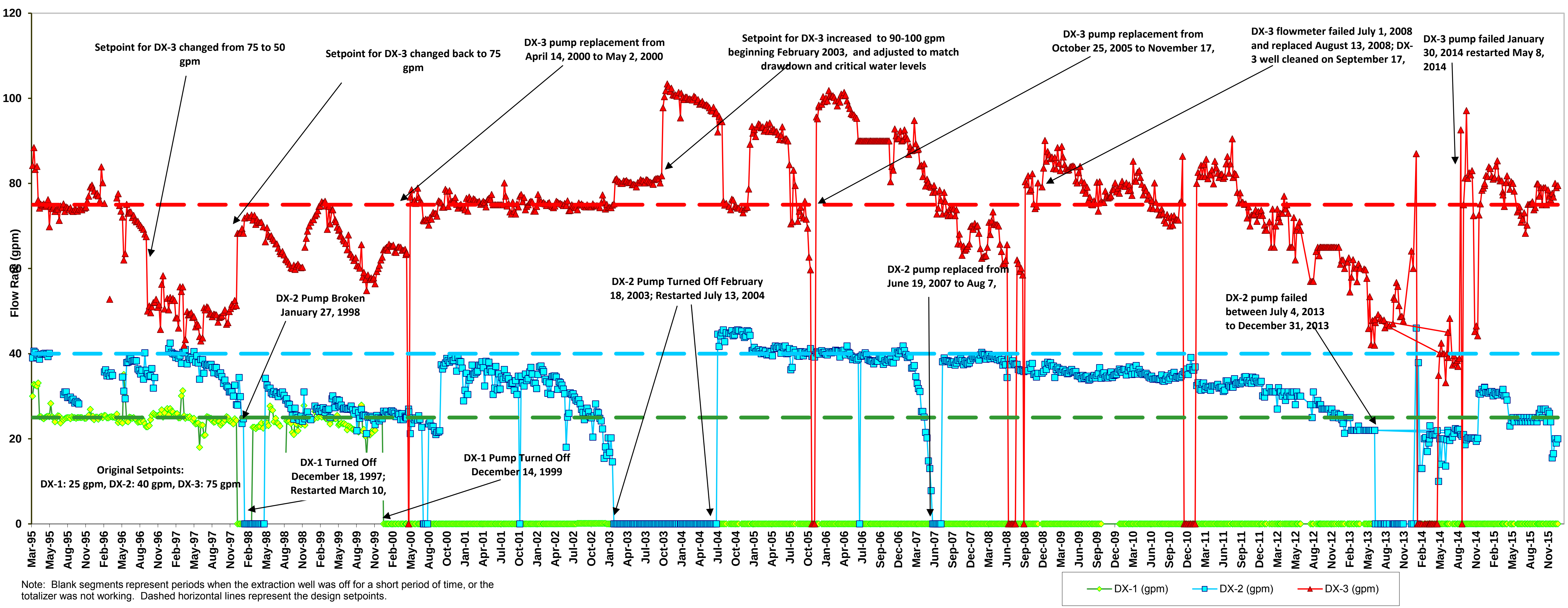
JBLM McChord Field
Area D/ALGT
2015 Annual Report

Figure 7-3b
Area D/ALGT GPT System Diagram

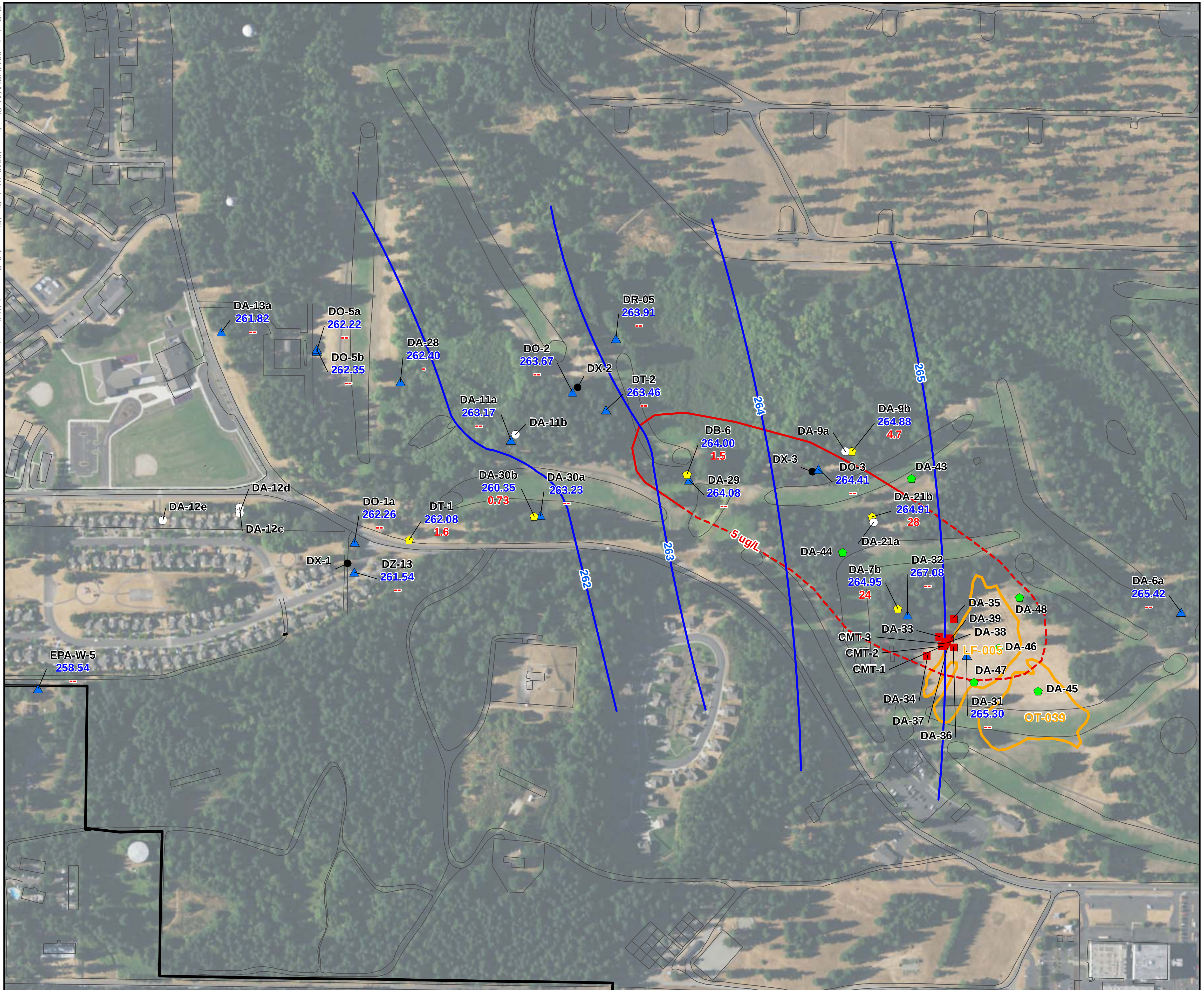
Date: 2/2016

TETRA TECH EC, INC.

Figure 7-4: Extraction Well Flow Rates 1995 to 2015 McChord Field Area D/ ALGT



Note: Blank segments represent periods when the extraction well was off for a short period of time, or the totalizer was not working. Dashed horizontal lines represent the design setpoints.



Resource Protection Well Not Sampled
No Groundwater Elevation Measured

PNNL Study Site
Resource Protection/Injection Well

Resource Protection Well
Groundwater Elevation Measured

Resource Protection Well
Groundwater Elevation Measured and a Sample Collected

System Extraction Well

Proposed New Resource Well

Base Boundary

Basemap

Contours - Groundwater Elevation (2015)

Contours - TCE Concentration (2015)

Labels

Well ID: DA-7B

Groundwater Elevation (Ft/AMSL): 264.95

TCE Concentration (ug/L): 24

Not Measured: --

IRP Site LF-005 and OT-039 boundaries approximated from RI Report (Ebasco 1991).

N

0 250 500 1,000
Feet

Figure 7-5
Proposed New Resource Well Locations

Date: 6/2016

TETRA TECH EC, INC.

R:\Projects_2014\JBLM\McChord\maps\2016_Work_Plan\Figure_1-2_Proposed_Wells.mxd

Appendix 3

Site Visit Photo Log

Public Notices

Example LUC Inspection Checklist from 2016

Administrative Record Storage Building

Administrative Record in Storage Building

Landfill 4 – Unknown Well Smashed by a tree

Used GAC vessels at SRCPP

Partially abandoned well house at SRCPP

SRCPP – Well hit by tree

ALGT signage

ALGT groundwater treatment building

Illicit PCB Dump Site gate and sign

Logistics Center – Landfill 2

Logistics Center – Landfill 2 groundwater treatment system, discharge pumps and gate

Logistics Center – Landfill 2 groundwater treatment system air stripper tower

Logistics Center – Landfill 2, Formal Thermal Area 3 (left) and 2 (right)

Logistics Center – I-5 groundwater treatment system

Logistics Center – Sea Level Aquifer Extraction Well Piping

Logistics Center – Sea Level Aquifer air stripper and piping

Pesticide Rinse Area

Landfill 4 – Unlocked monitoring well (AS/SVE wells in background)

Battery Acid Pit

Gate Entering DRMO Yard

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US ARMY CORPS OF EGNINEERS
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KANSAS CITY, MO 64106

PUBLIC NOTICE
FIFTH JOINT BASE LEWIS-MCCHORD, WASHINGTON INSTALLATION-WIDE FIVE-YEAR REVIEW (FYR) OF THE ENVIRONMENTAL CLEANUP PROGRAM

The U.S. Army is initiating the fifth Five-Year Review (FYR) of installation environmental cleanup sites at Joint Base Lewis-McChord (JBLM), Washington. The FYR will be conducted by team members from U.S. Army Corps of Engineers, JBLM, and the U.S. Army Environmental Command. The FYR document will be reviewed by the U.S. Environmental Protection Agency Region 10 and the Washington State Department of Ecology.

This fifth FYR will evaluate the effectiveness of the cleanup remedies and determine whether the remedies continue to be protective of human health and the environment. The FYR is being conducted to meet the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. This FYR evaluates JBLM sites which have a published Record of Decision or Decision Document specifying the selected cleanup action remedy, including the following sites:

Site Description	
Logistics Center (FTLE-33)	Landfill 4 (FTLE-57)
Battery Acid Pit (FTLE-16)	Pesticide Rinse Area, Bldg 2054 FTLE-28)
Defense Reutilization and Marketing Office Yard (FTLE-31)	Illicit Polychlorinated Biphenyls Dump Site (FTLE-46)
Industrial Wastewater Treatment Plant (FTLE-51)	Landfill 1 (FTLE-54)
Solvent Refined Coal Pilot Plant (FTLE-32)	American Lake Garden Tract (MF-ALGT-LF-05)

Interested members of the public are invited to provide input for the FYR by contacting the Program Manager as identified in the following paragraph. A public notice announcing the completion and two locations of the Final FYR Report will be published after finalization, in September 2017.

For more information or questions about the FYR, contact Meseret Ghebresllassie of the JBLM Installation Restoration Program at Meseret.C.Ghebresllassie.civ@mail.mil or 253.477.3742

JANICE WASSENAAR, being duly sworn, deposes and says: That he/she is the Principal Clerk of the publication; The News Tribune, printed and published in Tacoma, Pierce County, State of Washington, and having a general circulation therein, and which said newspaper(s) have been continuously and uninterruptedly published in said County during a period of six months prior to the first publication of the notice, a copy of which is attached hereto: that said notice was published in The News Tribune, as amended, for:

1 Insertions

Published On:
September 15, 2016

(Principal Clerk)

Subscribed and sworn on this 15th day of September in the year of 2016 before me, a Notary Public, personally appeared before me Janice Wassenaar known or identified to me to be the person whose name subscribed to the within instrument, and being by first duly sworn, declared that the statements therein are true, and acknowledged to me that he/she executed the same.

PENNY L WILCOX
NOTARY PUBLIC
COMMISSION EXPIRES 07-21-20
STATE OF WASHINGTON

Penny L Wilcox

Notary Public in and for the state of Washington, residing in Pierce County 1950 S. State St, Tacoma, WA 98405

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US ARMY CORPS OF EGNINEERS

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540067

Payor Account
540067

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KANSAS CITY MO 64106 USA

Payor Address
601 E 12TH ST
KANSAS CITY MO 64106 USA

Customer Phone
816-389-3462

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816-389-3462

Customer Fax

Customer EMail
Anne.D.Songer@usace.army.mil

Sales Rep
crochefort@thenewstribune.com

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crochefort@thenewstribune.com

PO Number	Payment Method	Blind Box	Tear Sheets	Proofs	Affidavits
JBLM 5 YR	Check		0	0	1

Net Amount	Tax Amount	Total Amount	Payment Amount	Amount Due
$311.57	$0.00	$311.57	$0.00	$311.57

Ad Order Number	Order Source	Ordered By	Special Pricing
0002672716		ANNE SONGER	

Invoice Text
JBLM 5 YR

Promo Type

Materials

Ad Order Information

Ad Number	Ad Type	Production Method	Production Notes
0002672716-01	TAC-Legal Liner	AdBooker	

External Ad Number	Ad Attributes	Ad Released	Pick Up
		No	

Ad Size	Color
2 X 27 li	

Product	Placement	Times Run	Schedule Cost
TAC-NT-News Tribune	0300 - Legals Classified	1	$238.66

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Product	Placement	Times Run	Schedule Cost
TAC-upsell.thenewstribune.com	0300 - Legals Classified	1	$63.36

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PUBLIC NOTICE

Position
0301 - Legals & Public Notices

Run Dates
09/14/2016

PUBLIC NOTICE
FIFTH JOINT BASE LEWIS-MCCHORD, WASHINGTON INSTALLATION-WIDE FIVE-YEAR REVIEW (FYR) OF THE ENVIRONMENTAL CLEANUP PROGRAM

The U.S. Army is initiating the fifth Five-Year Review (FYR) of installation environmental cleanup sites at Joint Base Lewis-McChord (JBLM), Washington. The FYR will be conducted by team members from U.S. Army Corps of Engineers, JBLM, and the U.S. Army Environmental Command. The FYR document will be reviewed by the U.S. Environmental Protection Agency Region 10 and the Washington State Department of Ecology.

This fifth FYR will evaluate the effectiveness of the cleanup remedies and determine whether the remedies continue to be protective of human health and the environment. The FYR is being conducted to meet the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. This FYR evaluates JBLM sites which have a published Record of Decision or Decision Document specifying the selected cleanup action remedy, including the following sites:

Site Description	
Logistics Center (FTLE-33)	Landfill 4 (FTLE-57)
Battery Acid Pit (FTLE-16)	Pesticide Rinse Area, Bldg 2054 FTLE-28)
Defense Reutilization and Marketing Office Yard (FTLE-31)	Illicit Polychlorinated Biphenyls Dump Site (FTLE-46)
Industrial Wastewater Treatment Plant (FTLE-51)	Landfill 1 (FTLE-54)
Solvent Refined Coal Pilot Plant (FTLE-32)	American Lake Garden Tract (MF-ALGT-LF-05)

Interested members of the public are invited to provide input for the FYR by contacting the Program Manager as identified in the following paragraph. A public notice announcing the completion and two locations of the Final FYR Report will be published after finalization, in September 2017.

For more information or questions about the FYR, contact Meseret Ghebresllassie of the JBLM Installation Restoration Program at Meseret.C.Ghebresllassie.civ@mail.mil or 253.477.3742

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Sales Rep
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PO Number	Payment Method	Blind Box	Tear Sheets	Proofs	Affidavits
JBLM 5 YR	Check		0	0	1

Net Amount	Tax Amount	Total Amount	Payment Amount	Amount Due
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Ad Order Number
0002672716

Order Source

Ordered By
ANNE SONGER

Special Pricing

Invoice Text
JBLM 5 YR

Promo Type

Materials

Ad Order Information

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		No	

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Position
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Position
0301 - Legals & Public Notices

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09/14/2016

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For more information or questions about the FYR, contact Meseret Ghebresllassie of the JBLM Installation Restoration Program at Meseret.C.Ghebresllassie.civ@mail.mil or 253.477.3742

JOINT BASE LEWIS-MCCHORD
PUBLIC AFFAIRS OFFICE

MEDIA RELATIONS (253) 967-0152
After hours: (253) 967-0015, ask for PAO

News Release #009-17
March 2, 2017

JBLM notifies on-base consumers of discontinued use of three of JBLM's 28 drinking water wells in accordance with new EPA guidelines for acceptable PFOS, PFOA levels

JOINT BASE LEWIS-MCCHORD, Wash. – Over the past several months, the Army is testing drinking water on its installations for the presence of perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), two manmade chemicals found in many consumer and industrial products.

In accordance with Environmental Protection Agency Safe Drinking Water Act guidelines, JBLM is notifying on-base consumers of drinking water that three of the base's 28 drinking water wells have been shut down and removed from the base drinking water system because they exceed the new EPA lifetime health advisory level (LHA) for PFOS and PFOA.

The remaining 25 wells will be used to meet JBLM's drinking water needs.

JBLM's drinking water is safe to drink.

To ensure the continued availability of safe drinking water for JBLM residents and employees, JBLM will continue a program of recurring sampling of drinking water sources for PFOS and PFOA and other requirements of the Safe Drinking Water Act.

[See attached JBLM Drinking Water Sampling Results Notification]

BACKGROUND:

- **April 2016** – When the PFOS/PFOA subject arose within DoD, JBLM's Public Works Environmental Division proactively tested the base drinking water wells for PFOS/PFOA as part of the installation's routine compliance with the Safe Drinking Water Act.
    - The April 2016 test included 23 active wells; five wells were off-line for maintenance and were not tested.
- **May 2016** – After JBLM completed initial testing, the EPA issued a Lifetime Health Advisory level for PFOS and PFOA in drinking water of 70 parts per trillion (ppt). As part of the Army's commitment to supplying quality drinking water to its Service members, family members, and civilians, the Army implemented a comprehensive PFOS and PFOA testing program.
- **June 2016** – JBLM received the April test results for the 23 active wells. Test data indicated two wells—one on McChord Field, and one on Lewis Main—had levels of PFOS/PFOA which exceeded the EPA LHA levels. Both wells were shut down and isolated from the JBLM drinking water system.
- **November 2016** – 28 of JBLM's drinking water wells were tested for PFOS/PFOA presence (five which were previously off-line for maintenance were tested for the first time).
- **January 9, 2017** – Lab results confirmed previous test results and also confirmed excessive levels of PFOS/PFOA in one of the previously untested wells located on McChord Field. To date, three of JBLM's 28 drinking water wells—two on McChord Field and one on Lewis Main—have been shut down and removed from the base's drinking water system because they exceeded the new EPA LHA for PFOS and PFOA.

-end-

Note: A total of 19 of the 23 permitted water supply wells were sampled in April 2016 and 21 of the 23 wells and 7 points within the water distribution system were sampled in November 2016. Wells that were not sampled were either offline or inoperable and could not be sampled.

JOINT BASE LEWIS MCCHORD (JBLM)

DRINKING WATER SAMPLING RESULTS NOTIFICATION

Three JBLM Drinking water wells removed from the base water system after exceedance of new EPA lifetime health advisories

*** This notice pertains to the people who work or live on JBLM only**

BOTTOM LINE

Over the past several months, the Army has been testing drinking water on its installations to ensure levels of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) are below the May 2016 U.S. Environmental Protection Agency (EPA) Lifetime Health Advisory (LHA) level of 70 or fewer parts per trillion (ppt). There have been 140 installations tested to date, and six were identified with levels exceeding 70 ppt. At each of these six installations, Army has taken actions (e.g., shutting down wells, connecting to municipal water supplies, etc.) to ensure that water is being provided below the LHA. Army testing will continue in order to ensure drinking water remains below the LHA.

PFOS and PFOA are two manmade chemicals found in many consumer and industrial products. The Agency for Toxic Substances and Disease Registry (ATSDR) reports that most people in the United States have PFOS and/or PFOA in their blood, regardless of age. In addition to drinking water, examples of ways individuals are exposed to PFOS and PFOA include consuming food cooked using cookware with non-stick coatings or inhalation of household dust generated from coatings on clothing and carpets.

***EPA lifetime health advisory level**

Health Advisory levels include a significant margin of safety to ensure they are protective of even the most sensitive populations. Until more research is conducted to confirm or rule out the possible associations between PFOS and PFOA exposure and potential negative health effects, the Army is being proactive and reducing PFOS and PFOA exposure in drinking water to the extent possible. If you have concerns about your health or the health of your family members please contact your primary healthcare provider or pediatrician.

28 wells that provide JBLM drinking water were recently tested for the presence of PFOS and PFOA. As a result, three wells were shut down and isolated from the base water system because they exceeded the *EPA lifetime health advisory level for PFOS and PFOA.

The remaining 25 wells will be used to meet JBLM's drinking water needs. JBLM's drinking water is safe to drink.

JBLM leadership is committed to providing safe drinking water for everyone served by JBLM Water systems. They are working to identify, fix and prevent adverse impacts created by these chemicals in JBLM's water supply.

BACKGROUND - TIMELINE

<u>Background—</u>

PFOS and PFOA are manufactured fluorinated organic chemicals. They have been used in carpets, clothing, furniture fabric, paper packaging for food, and other materials (e.g., cookware) that is resistant to water, grease or stains. Also PFOS and PFOA are components of aqueous film forming foam (AFFF), a firefighting foam used by industry and DoD since 1970 to fight petroleum fires. AFFF was used for firefighter training at several locations on the east side of McChord Field's runway and on Lewis Main's Gray Army Airfield through the early 1990's.

Use of AFFF that contained PFOS and PFOA was discontinued more than 20 years ago. JBLM firefighters no longer train with it.

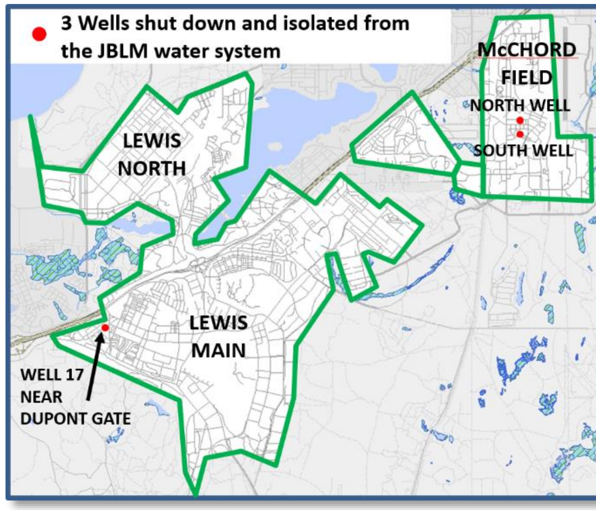
While consumer products and food are the primary exposure sources, drinking water can be an exposure source in a small percentage of communities where these chemicals have contaminated drinking water supplies. Such contamination is typically local and associated with a specific facility where the chemicals were produced, used to manufacture other products, or used for airfield firefighting.

Timeline—

April 2016: JBLM water systems are tested routinely in accordance with the Safe Drinking Water Act. When the PFOS/PFOA subject arose within DoD, JBLM proactively tested its wells in April 2016 for PFOS/PFOA.

- The initial test included 23 JBLM wells. Five JBLM wells off-line for maintenance were not tested.

May 2016: EPA issued a LHA level for PFOS and PFOA in drinking water of 70 parts per trillion (ppt) (or 0.07 µg/l) for each chemical; or if PFOS and PFOA both appear in a drinking water sample, the combined LHA level is also 70 ppt. As part of the Army's commitment to supplying quality drinking water to its Service members, Family Members, and Civilians, the Army implemented a comprehensive PFOS and PFOA testing program.



June 2016: Upon receipt and analysis of the lab report from the April sampling event, it was determined that of the 23 wells tested in April, two—the "North Well" on McChord Field and "Well 17" near the DuPont Gate on Lewis Main exceeded the new EPA advisory level. The North Well was shut down and isolated from the JBLM drinking water system. Seasonal Well 17 wasn't turned on in 2016. It remains turned off and isolated from the JBLM drinking water system.

November 2016: 28 JBLM drinking water wells tested: 23 wells were retested and wells that were out of service in April 2016 were tested for the first time.

January 2017: November's test results were received from the laboratory on January 9, 2017, and verified the "North Well" and "Well 17" exceeded the 70 ppt EPA advisory level. This test also confirmed McChord Field's "South Well," which was down for repairs and not tested in April 2016, exceeded 70 ppt. Three wells are shut down and isolated from service in the JBLM drinking water system.

The McChord Field "North" and "South" wells served the McChord Field industrial area drinking water system, not the McChord Field housing area in the Carter Lake vicinity. Three other wells supply the housing area. Test results for these wells showed almost zero readings for PFOS/PFOA.

- The PFOS/PFOA reading of the McChord Field North Well was 216 ppt
- The PFOS/PFOA reading of the McChord Field South Well was 250 ppt
- The PFOS/PFOA reading of Well 17 Lewis Main was 71 ppt

Other JBLM drinking water wells and springs test results fell below 70 ppt.

JBLM NOTIFICATION

The JBLM Directorate of Public Works is providing this public notice to users of the JBLM drinking water system in accordance with EPA Safe Drinking Water Act guidelines. The Washington Department of Health was provided with a copy of all PFOS/PFOA data collected to date. As more information becomes available, updates will be provided.

JBLM WAY FORWARD

JBLM Directorate of Public Works - Water Section has taken the following actions:

Wells. The three drinking water wells that tested above the 70 ppt EPA lifetime Public Health Advisory Level – two main production wells (McChord Field North and South) for the McChord Field drinking water system and one seasonal drinking water well (Well 17) in the Lewis Main drinking water system – were isolated from service and will remain in this status indefinitely. Wells that tested below the 70 ppt level will be used to make up for lost capacity.

Other Actions:

- Notice of this situation is being provided to all consumers.
- Investigation for treatment options for the affected wells is underway.
- Other source wells and springs water were sampled and did not exceed the 70 ppt health advisory.
- A program of recurring sampling of JBLM drinking water sources for PFOS and PFOA is being implemented.
- Before any of the three isolated wells are returned to use, public notice will be provided, which will include additional test results for PFOS and PFOA and an explanation of treatment or other actions taken to return the well(s) to service.
- When additional information becomes available this public notice will be updated.
- JBLM will continue to work closely with subject matter experts from the Office of the Army Assistant Chief of Staff for Installation Management and the Army Public Health Center to ensure appropriate steps are taken regarding PFOS and/or PFOA in drinking water.

Removing the three wells from service makes JBLM drinking water safe for consumers, and allows for use in drinking, cooking, washing dishes and clothes, brushing teeth, bathing, and showering. Although trace amounts of PFOS/PFOA were found in operational McChord Field main base drinking water wells, these wells measure below the 70 ppt health advisory level.

If you have specific health concerns regarding your exposure, you should consult your doctor.

POTENTIAL ADVERSE HEALTH EFFECTS WITH EXPOSURE TO PFOS AND PFOA

In May 2016, the United States Environmental Protection Agency (EPA) issued a Lifetime Health Advisory (LHA) level in drinking water of 70 parts per trillion (ppt) for PFOS/PFOA (individually or combined if both are detected in drinking water). EPA's LHA levels include a significant margin of safety to ensure they are protective of the most sensitive sub-populations while drinking the water over a lifetime. The EPA LHA levels are based on the effects of PFOS and PFOA on laboratory animals and epidemiological studies of human populations. For context, one (1) ppt is equivalent to one (1) drop of water in 20 Olympic-sized swimming pools.

The ATSDR recently concluded that studies performed to date in humans and animals are inconsistent and inconclusive, and additional research is needed to determine the effects of PFOS and PFOA. ATSDR also states that a connection between PFOS and PFOA exposure and cancers continues to be evaluated.

FOR ADDITIONAL INFORMATION ON PFOS and PFOA SEE:

EPA's Drinking Water Health Advisories for PFOS and PFOA can be found at: https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisories-pfoa-and-pfos

EPA's FACT SHEET for PFOS and PFOA Drinking Water Health Advisories can be found at: https://www.epa.gov/sites/production/files/2016-06/documents/drinkingwaterhealthadvisories_pfoa_pfos_updated_5.31.16.pdf

The Centers for Disease Control and Prevention's Public Health Statements for PFOS and PFOA can be found at: http://www.atsdr.cdc.gov/phs/phs.asp?id=1115&tid=237

For more detailed information about PFOS and PFOA, please read the list of frequently asked questions.

For health-related questions, please contact Madigan Army Public Affairs at 253-968-1901.

For other questions, please contact the JBLM Public Affairs at 253-967-0148 or 0158.

JBLM CERCLA LUC MONITORING CHECKLIST

Lewis-Main & McChord Field

A. FIELD INSPECTION **Date(s):** 1/20/16 ; 1/28/16

Site	Question	Answer
Logistics Center	1. Any family housing within Landfill 2 or within 100 µg/L groundwater contour?	Yes / No
	2. Any obvious recent construction/excavation within Landfill 2?	Yes / No
	3. Any obvious recent training activities within Landfill 2?	Yes / No
	4. Does Landfill 2 boundary fence and/or signs need maintenance?	Yes / No
Landfill 4	5. Any family housing within landfill boundary?	Yes / No
	6. Any obvious recent construction/excavation within landfill boundary?	Yes / No
	7. Any obvious recent digging, bivouacking, or off-road maneuvering in landfill?	Yes / No
Battery Acid Pit	8. Any family housing within site boundary?	Yes / No
	9. Any obvious recent construction/excavation within site boundary?	Yes / No
	10. Does asphalt cap need maintenance?	Yes / No
DRMO Yard	11. Any family housing within site boundary?	Yes / No
Illicit PCB Dump Site	12. Any family housing within site boundary?	Yes / No
	13. Any obvious recent construction/excavation within site boundary?	Yes / No
	14. Any obvious recent training activities within site boundary?	Yes / No
	15. Does boundary fence and/or signs need maintenance?	Yes / No
	16. Does clay cap need maintenance?	Yes / No
IWTP Site	17. Any family housing within site boundary?	Yes / No
Landfill 1	18. Any family housing within landfill boundary?	Yes / No
	19. Any obvious recent construction/excavation within landfill?	Yes / No
Pesticide Rinse Area	20. Any family housing within site boundary?	Yes / No
McChord Field Landfills 5, 6, 7 and OT-39	21. Any family housing within landfill boundary? 22. Any obvious recent construction/excavation within landfill boundary?	Yes / No Yes / No

23. Any comments (required for "Yes" answers to above)? **YES or NO** If yes, describe on back.

B. INTERVIEWS **Date(s):** 1/20/2016

Position	Name	Question	Answer
PW GIS Lab	THERESA HANSEN	24. Are you still storing LUC data layer in GIS?	Yes / No
		25. Is LUC data layer still available to GIS users?	Yes / No
Master Planner	GARY STEDMAN	26. Do you still have access to LUC data when you need it?	Yes / No
		27. Are you still using the LUC data for a Master Plan overlay?	Yes / No
NEPA Program Manager	CHRIS RUNNER	28. Do you still have access to LUC data when you need it?	Yes / No
		29. Are you still using the LUC data as environmental review overlay?	Yes / No
		30. Are training LUCs still included on the Environmental Coordination Map?	Yes / No
		31. Are you still using the LUC data for a digging permit overlay?	Yes / No
Cultural Resources PM	DONNA TURNIPSEED	32. Do you still have access to LUC data when you need it?	Yes / No
		33. Are you still using the LUC data for a digging permit overlay?	Yes / No
Range Operations	STUART WATSON	34. Are you still using Environmental Coordination Map as primary tool for implementing environmental LUCs under FLR 350-30?	Yes / No
Water Systems Manager	LYLE FOGG	35. Do you still have access to LUC data when you need it?	Yes / No
		36. Are WSP LUCs going to (be added / remain) in future WSP updates?	Yes / No
		37. Any existing drinking water wells within LUC boundaries besides Well 13, MAMC 4, Well 12A, Well 12B, Sage I and II, and Sequalitchew Springs?	Yes / No
		38. Any plans for new drinking water wells in JBLM Cantonment Area Water System?	Yes / No
LWD Water Quality Dept.	DAVE HALL	39. Any existing drinking water wells within Tillicum besides Well A-1?	Yes / No
		40. Any plans for new drinking water wells within Tillicum?	Yes / No

41. Any comments? (see instructions for required comments) **YES or NO** If yes, describe on back.
42. Any changes noted about how LUC processes are executed? **YES or NO** If yes, describe on back.

C. CERTIFICATION

Based on this monitoring, LUC processes appear to be working and achieving LUC objectives.

Tom [signature]
Signature

1/29/2016
Date

JOINT BASE LEWIS – MCCHORD CERCLA LUC MONITORING CHECKLIST COMMENTS

JANUARY 2015

GENERAL: Updated Contact List:

PW GIS Lab	Theresa Hansen	(253) 967-8029
Master Planner	Gary Stedman	(253) 966-1790
NEPA Program Manager	Chris Runner	(253) 966-1763
Cultural Resources PM	Donna Turnipseed	(253)-966-1766
Range Operations	Stuart Watson	(253) 967-1549
Water Systems Manager	Lyle Fogg	(253) 966-1692
LWD Water Quality Dept	Dave Hall	(253) 588-4423

A. FIELD INSPECTION

No comments.

B. INTERVIEWS

Question 34: Do not use Environmental Coordination Map as primary tool for implementing LUCs because there are conflicting data. Range Operations has own data set and is working on resolving inconsistencies.

Question 37: Existing water wells within LUC boundaries include Well 14, Well 17, and Well 20.

Appendix 4

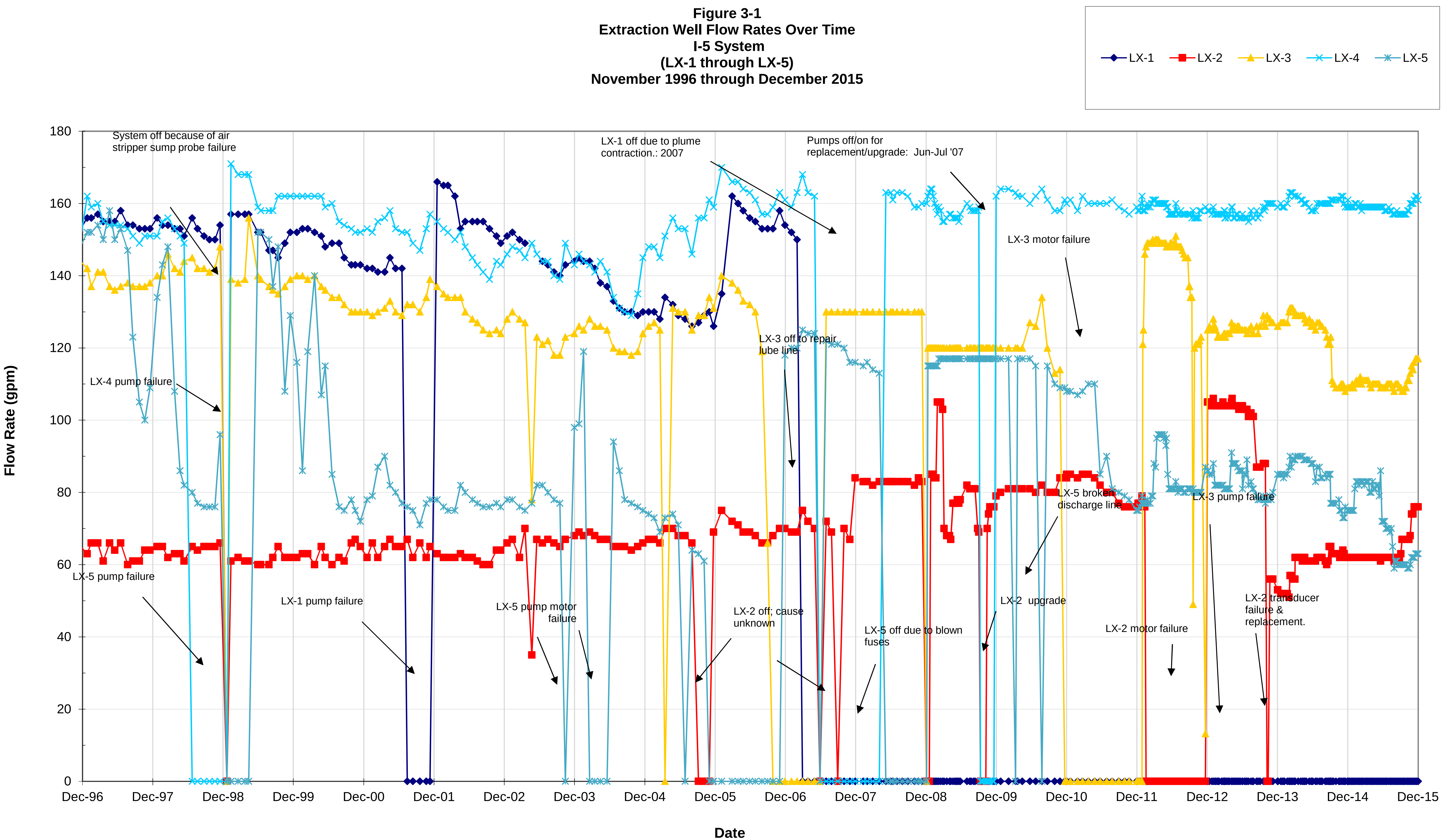
Site Specific Data:

Logistics Center Flow Rates

Logistics Center Trend Charts and Figures

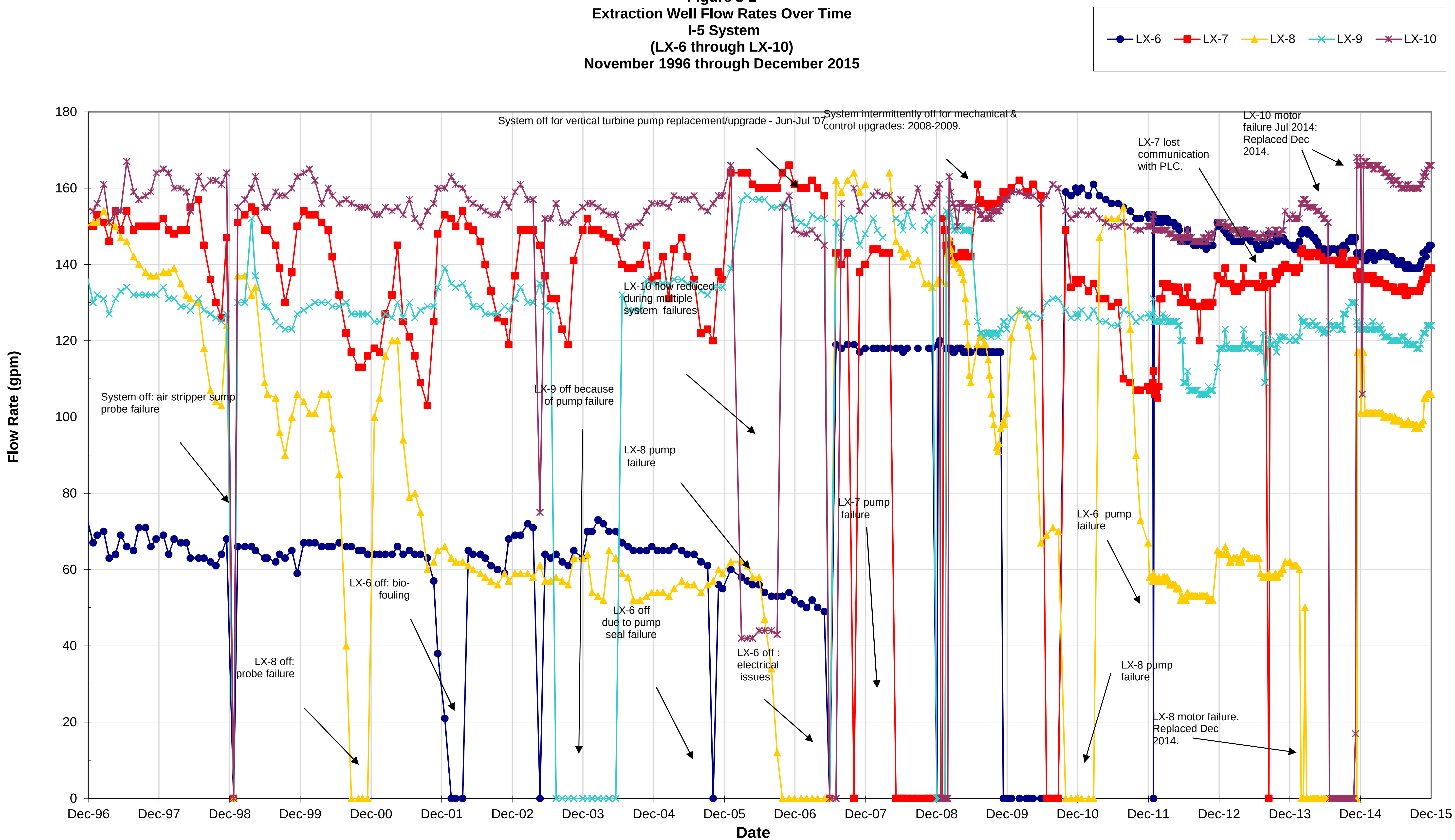
American Lake Garden Tract Trends Charts and Statistical Evaluation

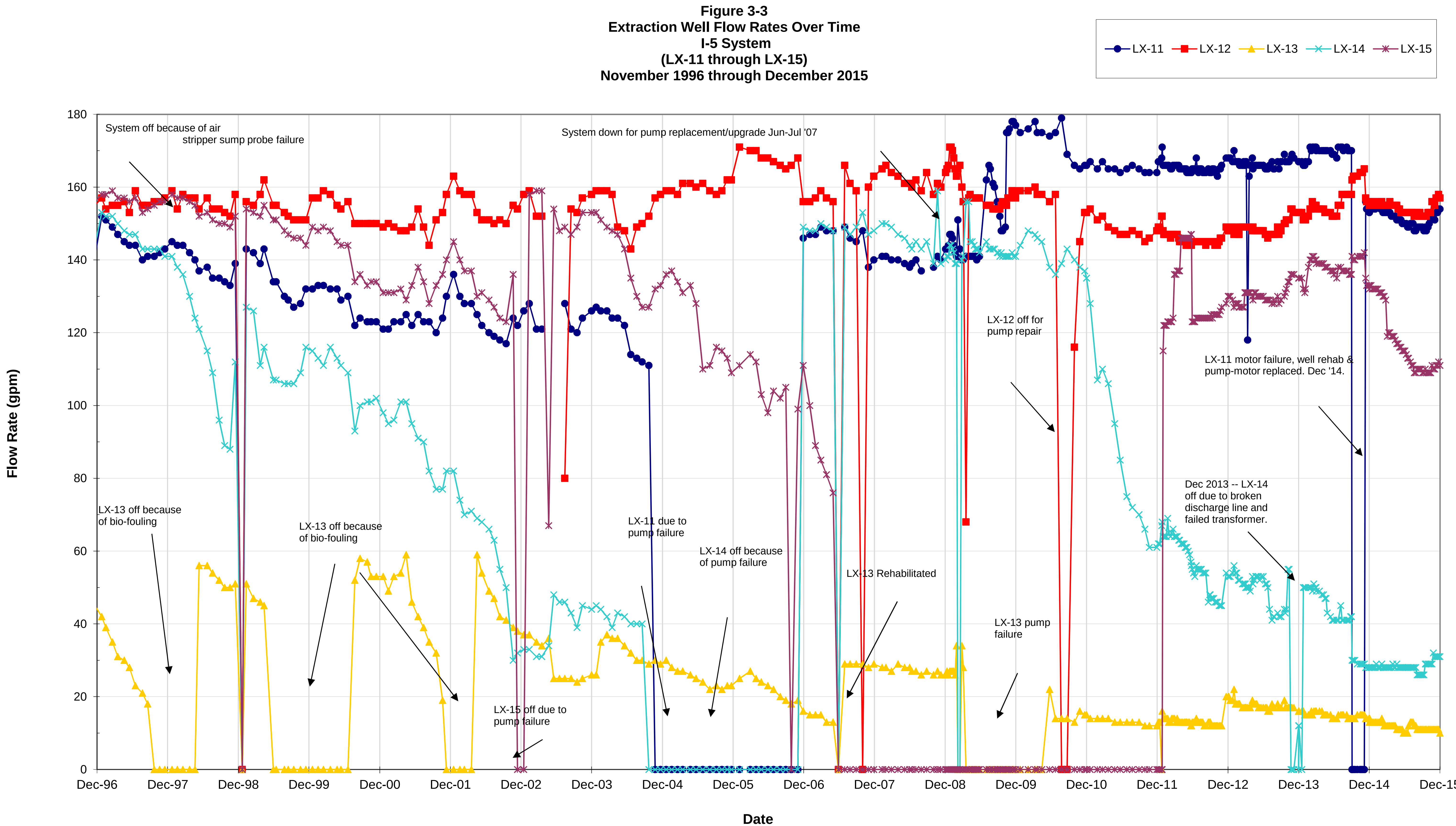
Figure 3-1
Extraction Well Flow Rates Over Time
I-5 System
(LX-1 through LX-5)
November 1996 through December 2015



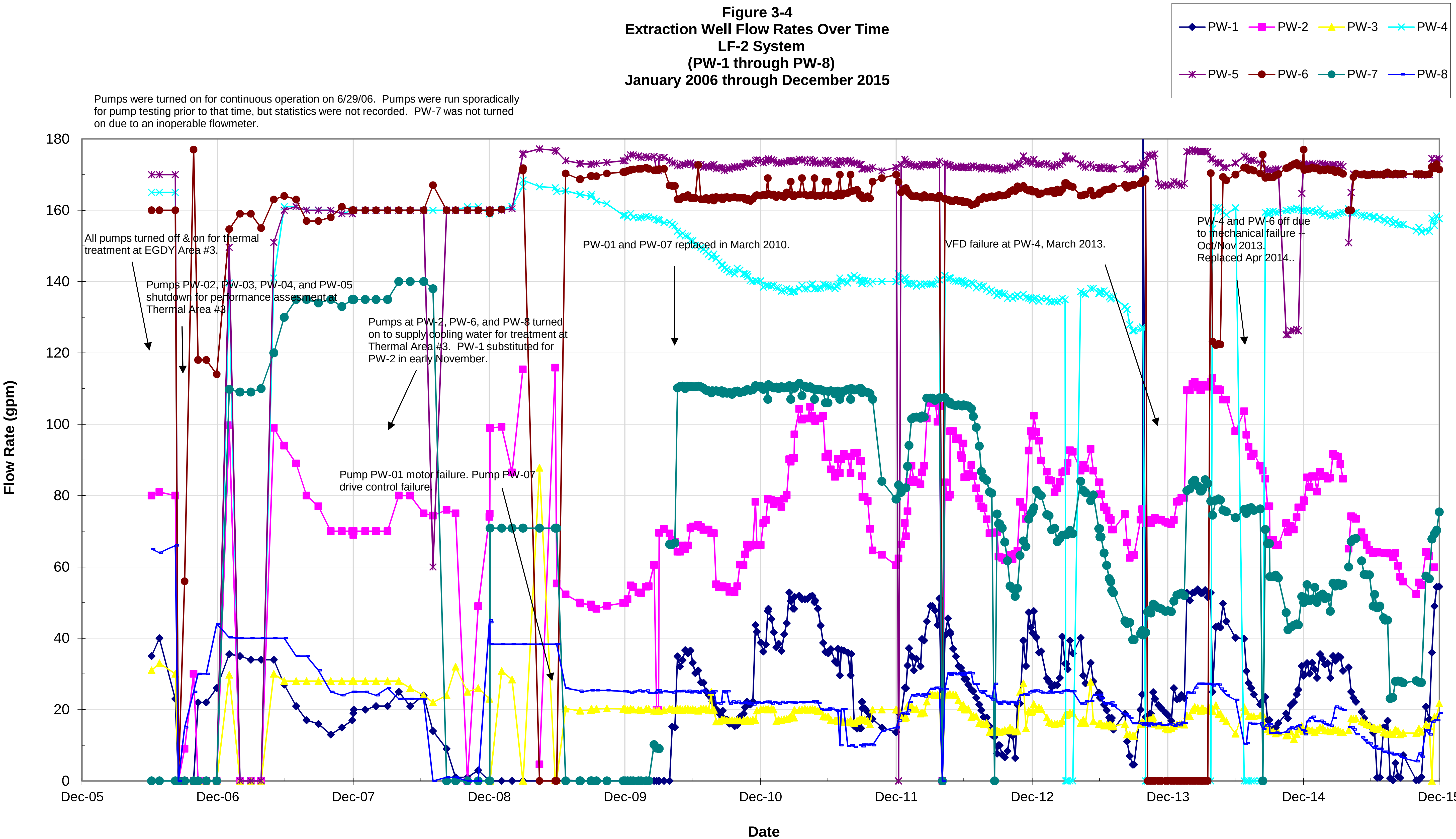
Note: Pump at LX-1 permanently off: March 5th, 2007. See text for explanation.

Figure 3-2
Extraction Well Flow Rates Over Time
I-5 System
(LX-6 through LX-10)
November 1996 through December 2015





Note: Pump at LX-15 turned off permanently on June 20th, 2007. See text for explanation.



Note: Pump at LX-15 turned off permanently on June 20th, 2007. See text for explanation.

Table 3-4
LF-2 Extraction Well Flow Rates

DATE	WATER FLOW RATES (gpm)								
	PW-1	**PW-2**	**PW-3**	**PW-4**	**PW-5**	**PW-6**	**PW-7**	**PW-8**	**Total**
12/31/2014	30	79	14	160	173	177	50	16	16
1/2/2015	*30*	*78*	*14*	*160*	*173*	*171*	*51*	*13*	690
1/9/2015	*33*	*85*	*15*	*160*	*173*	*172*	*55*	*17*	709
1/16/2015	*30*	*82*	*14*	*160*	*173*	*172*	*51*	*18*	699
1/23/2015	*33*	*85*	*14*	*160*	*173*	*172*	*51*	*18*	707
1/30/2015	*31*	*85*	*14*	*159*	*173*	*172*	*54*	*17*	705
2/5/2015	*29*	*81*	*14*	*160*	*173*	*172*	*50*	*17*	695
2/13/2015	*36*	*87*	*15*	*160*	*173*	*171*	*52*	*17*	711
2/20/2015	*34*	*85*	*15*	*159*	*173*	*171*	*52*	*16*	707
2/26/2015	*33*	*85*	*14*	*159*	*173*	*171*	*51*	*16*	702
3/6/2015	*33*	*85*	*14*	*159*	*173*	*172*	*51*	*16*	702
3/13/2015	*29*	*85*	*14*	*158*	*172*	*171*	*48*	*15*	693
3/20/2015	*35*	*92*	*14*	*159*	*173*	*171*	*55*	*18*	717
3/26/2015	*34*	*91*	*14*	*159*	*173*	*171*	*55*	*21*	717
1st Qtr. Avg. Rate (gpm)	**32**	**85**	**14**	**159**	**173**	**172**	**52**	**17**	**655**
4/3/2015	35	91	14	159	172	171	55	21	719
4/9/2015	35	89	14	159	173	171	55	20	715
4/16/2015	31	85	14	159	172	170	55	20	706
5/1/2015	32	65	14	160	151	160	60		0
5/8/2015	25	74	18	159	165	160	67	15	683
5/14/2015	23	74	17	159	170	169	68	15	696
5/21/2015	22	74	18	159	170	170	68	14	695
6/5/2015	19	70	17	159	170	170	62	13	679
6/12/2015	18	68	16	159	170	170	58		0
6/19/2015	16	66	16	158	170	170	58	12	666
6/26/2015	16	65	16	159	170	170	58	12	663
2nd Qtr. Avg. Rate (gpm)	**25**	**75**	**16**	**159**	**169**	**168**	**60**	**11**	**682**
7/6/2015	*14*	*64*	*15*	*158*	*170*	*170*	*49*	*9*	**649**
7/10/2015	14	64	15	158	170	170	52	10	653
7/17/2015	1	64	15	158	170	170	49	9	635
7/24/2015	1	64	15	158	170	170	49	9	636
8/3/2015	15	64	14	157	170	170	46	8	644

Table 3-4
LF-2 Extraction Well Flow Rates

DATE	WATER FLOW RATES (gpm)								
	PW-1	**PW-2**	**PW-3**	**PW-4**	**PW-5**	**PW-6**	**PW-7**	**PW-8**	**Total**
8/7/2015	15	64	14	157	170	170	45	8	643
8/14/2015	17	64	13	157	170	171	45	8	644
8/21/2015	1	64	14	157	170	170	23	8	607
8/28/2015	0	63	13	156	170	170	23	7	603
9/4/2015	5	64	14	157	170	170	28	8	616
9/11/2015	1	60	14	156	170	170	28	7	607
9/17/2015	1	57	13	156	170	170	28	7	602
9/25/2015	7	56	13	156	170	170	28	6	**607**
3rd Qtr. Avg. Rate (gpm)	**7**	**62**	**14**	**157**	**170**	**170**	**38**	10	667
10/1/2015	*8*	*54*	*13*	*155*	*170*	*170*	*27*	*6*	667
10/9/2015	10	54	13	154	170	170	27	6	604
10/16/2015	1	56	14	155	170	171	28	6	600
10/23/2015	1	53	14	154	170	170	27	6	595
10/30/2015	0	52	13	154	170	170	28	6	594
11/6/2015	0	56	15	155	170	170	28	8	601
11/13/2015	1	55	14	154	170	170	28	7	598
11/25/2015	21	64	16	154	170	170	57	14	667
12/4/2015	17	63	15	154	170	170	57	13	660
12/11/2015	36		18,1	158	175	172	68	17	625
12/18/2015	49	60	18	156	173	172	69	17	714
12/24/2015	54		18	158	175	173	70	17	**666**
12/31/2015	55		22	158	174	171	75	19	**644**
4th Qtr. Avg. Rate (gpm)	**20**	**57**	**15**	**155**	**171**	**171**	**45**		
Annual Avg. Rate (GPM)	**21**	**70**	**15**	**158**	**171**	**170**	**49**		

Notes:

Flow readings were read directly from the local display at each magmeter or from instantaneous readings at the PLC display in the control building.

PW-4 and PW-6 came back online in mid-April

PW-4 was not communicating with data logger from the end of July thru mid-September

avg - average

gpm - gallons per minute

gal - gallons

Figure 3-5
SLAP-1 Flow Rate

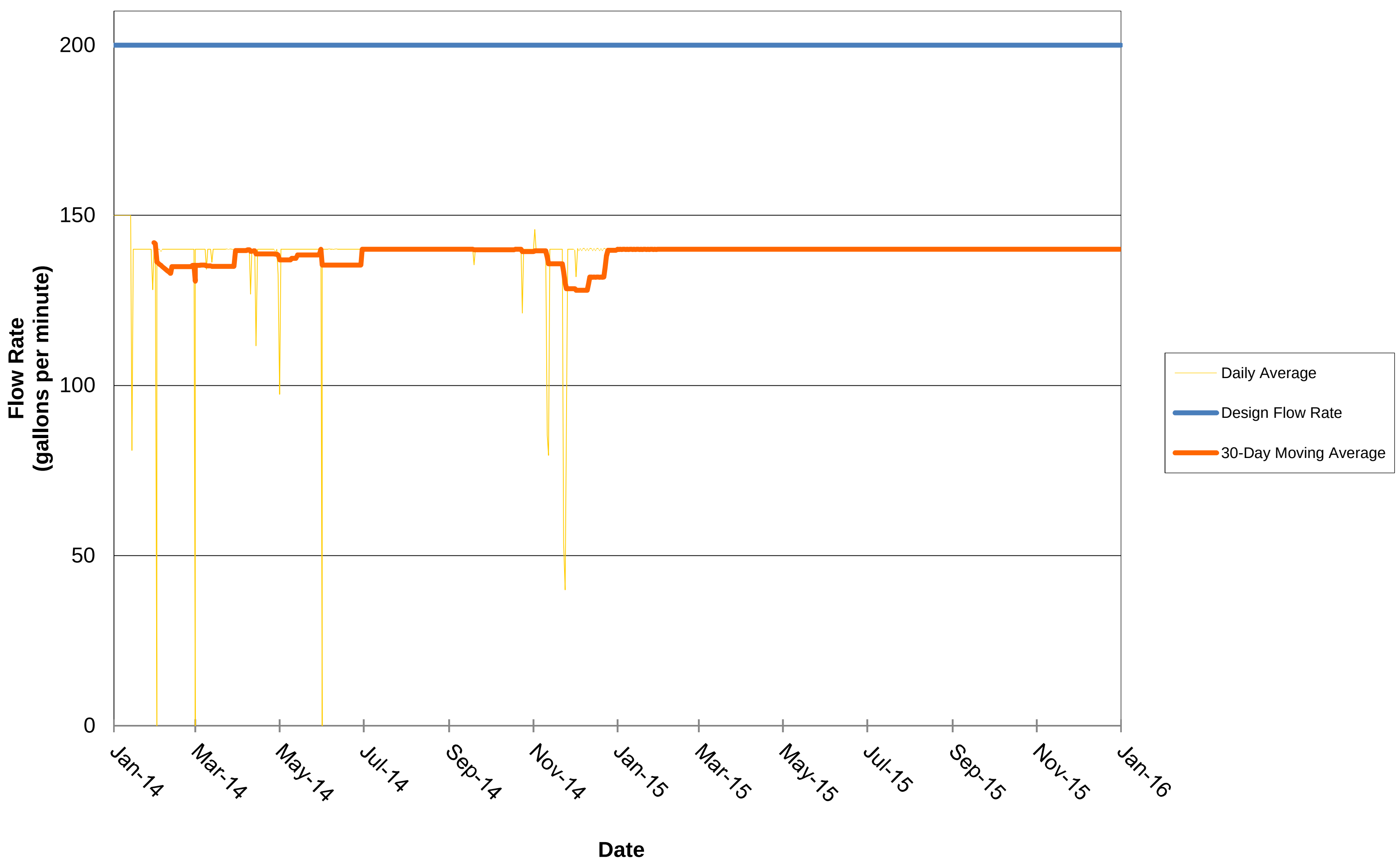


Figure 3-6
SLAP-2 Flow Rate

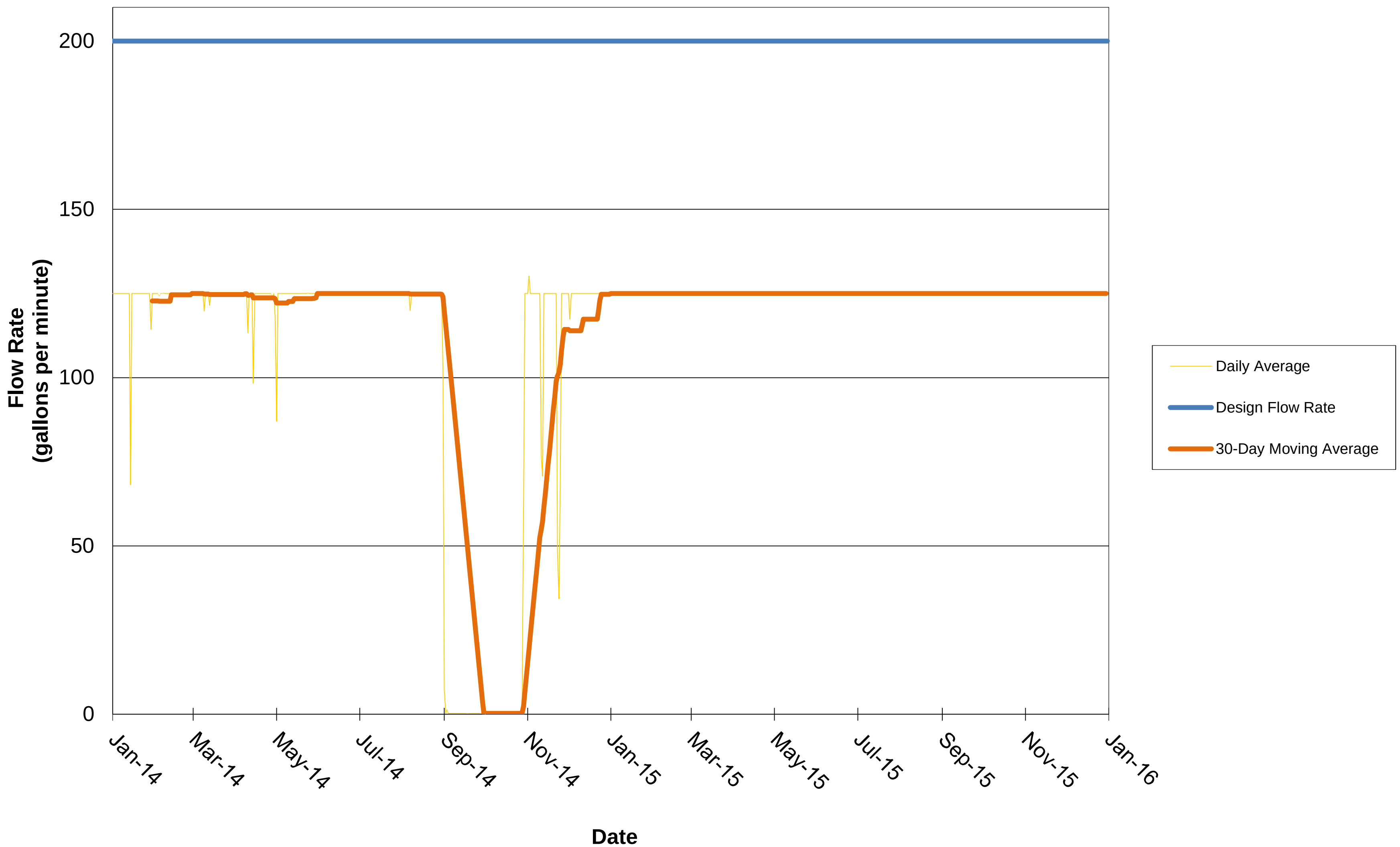


Figure 3-7
SLAP-3 Flow Rate

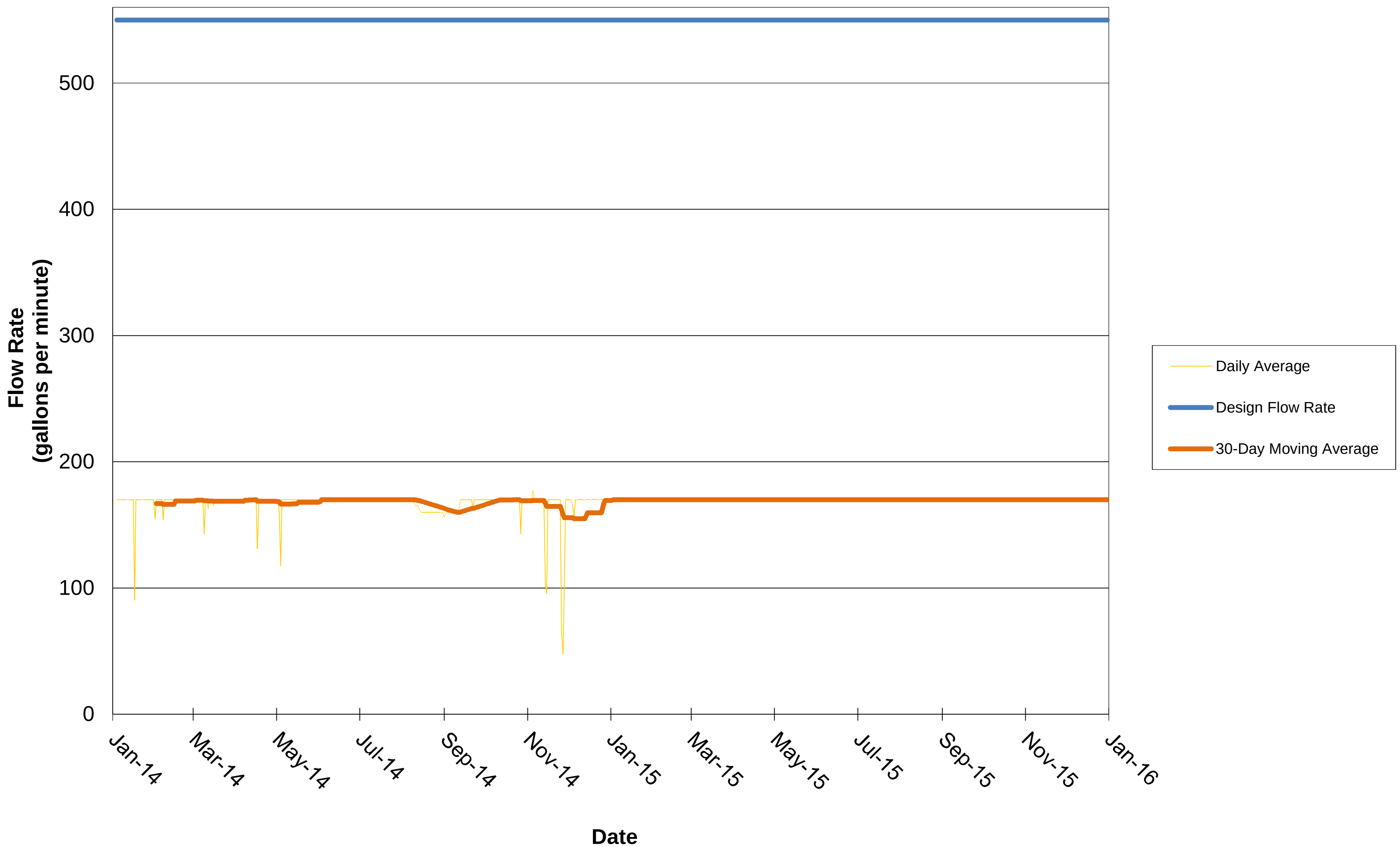


Figure 3-8
SLAP-4 Flow Rate

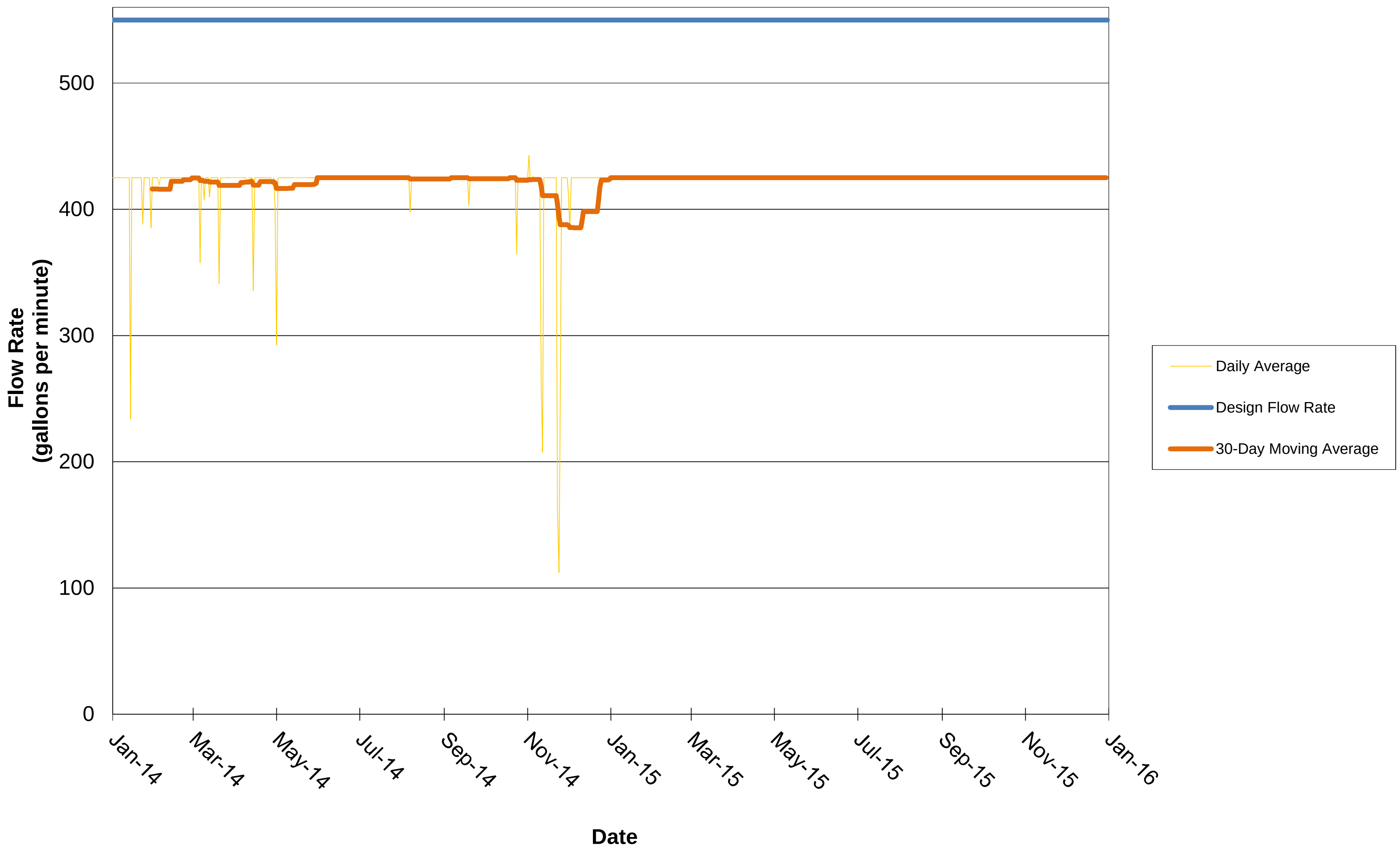
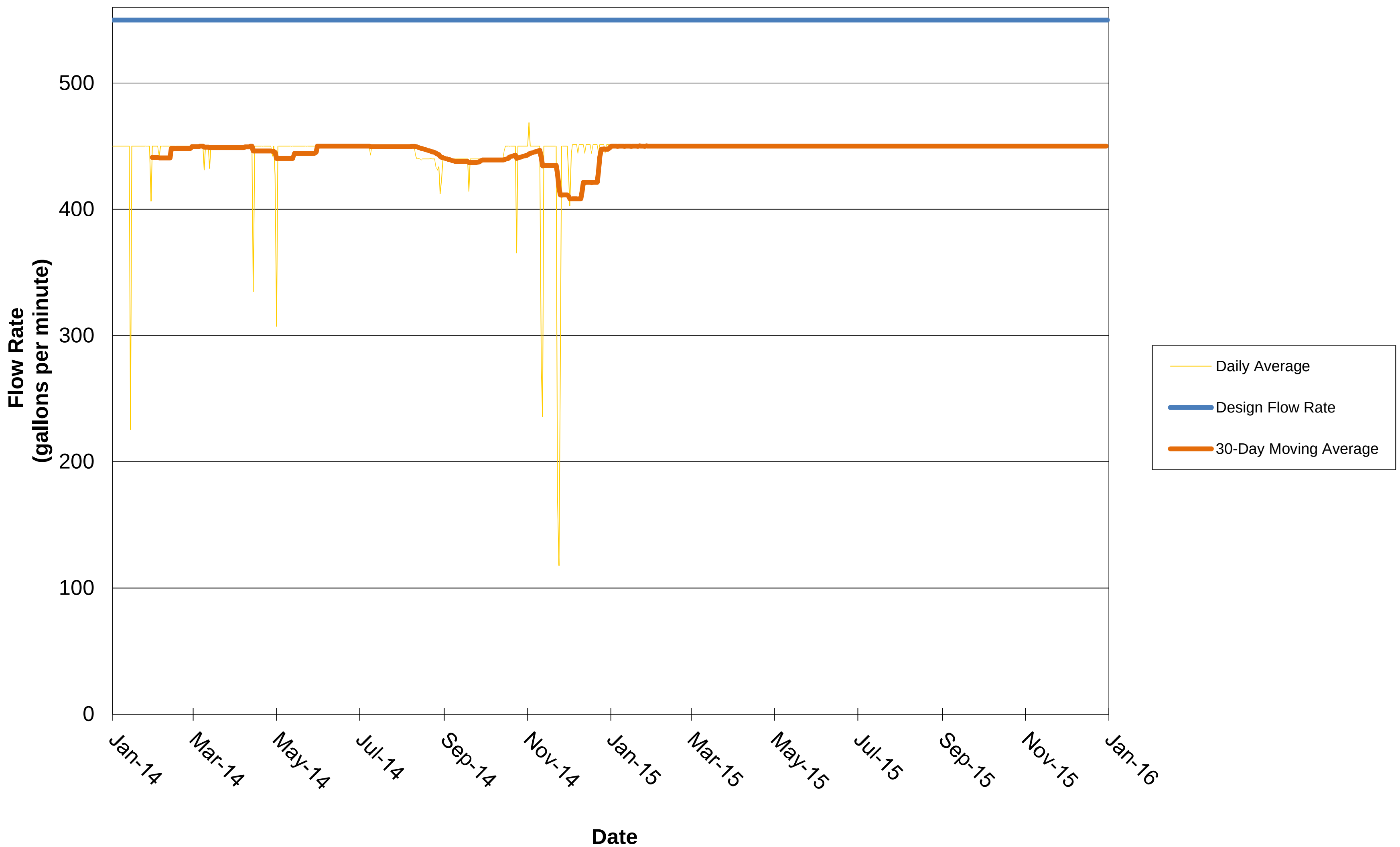


Figure 3-9
SLAP-5 Flow Rate



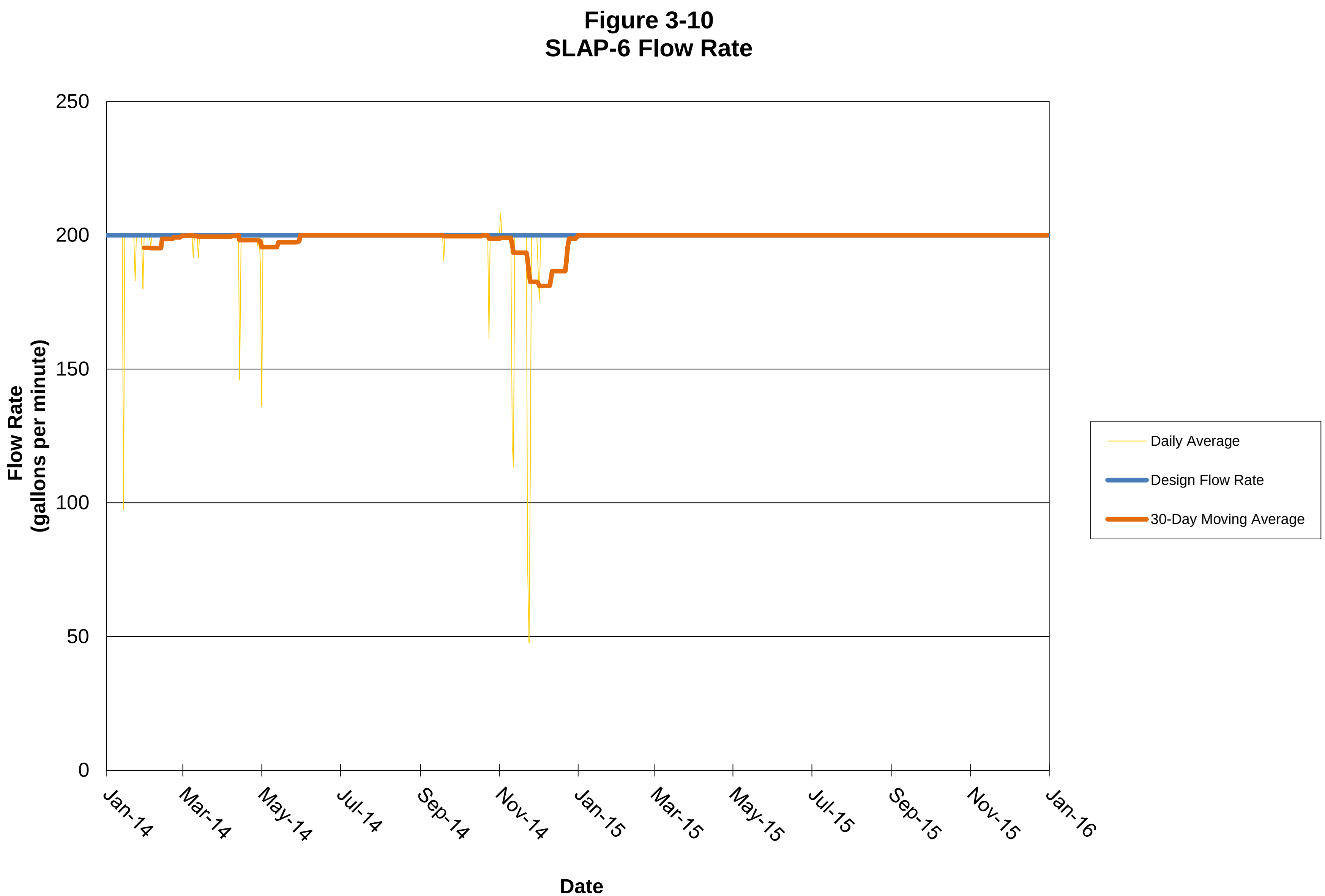
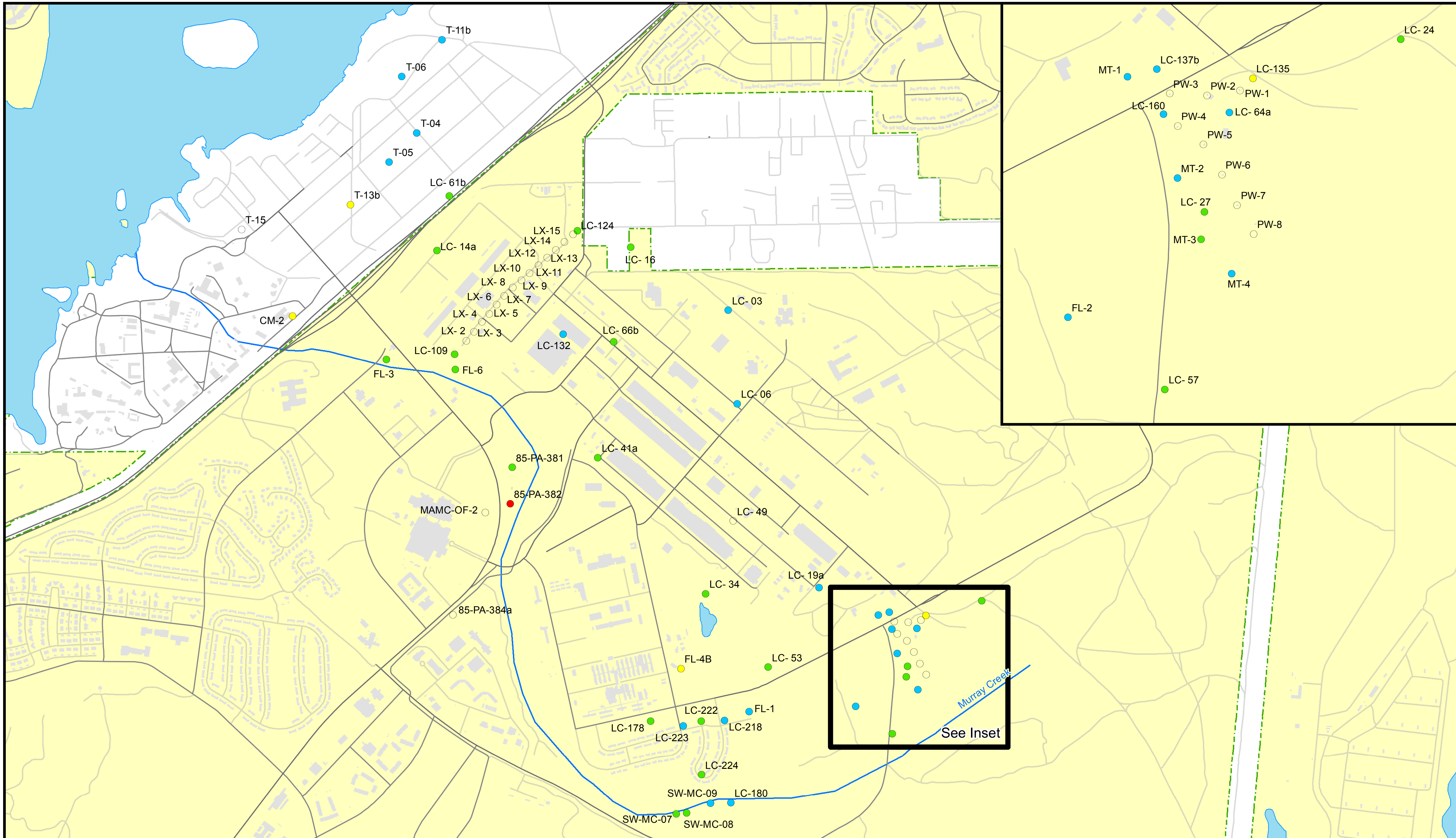


Figure 3-10
SLAP-6 Flow Rate
Flow Rate
(gallons per minute)
250
200
150
100
50
0
Jan-14
Mar-14
May-14
Jul-14
Sep-14
Nov-14
Jan-15
Mar-15
May-15
Jul-15
Sep-15
Nov-15
Jan-16
Date
Daily Average
Design Flow Rate
30-Day Moving Average



Legend

Sample Location and Trend Statistics

- Statistically Significant Upward Trend
- Not Statistically Significant Upward Trend
- Not Statistically Significant Downward Trend
- Statistically Significant Downward Trend
- Data Not Analyzed

N

0 625 1,250 2,500

Feet

1 inch = 1,375 feet

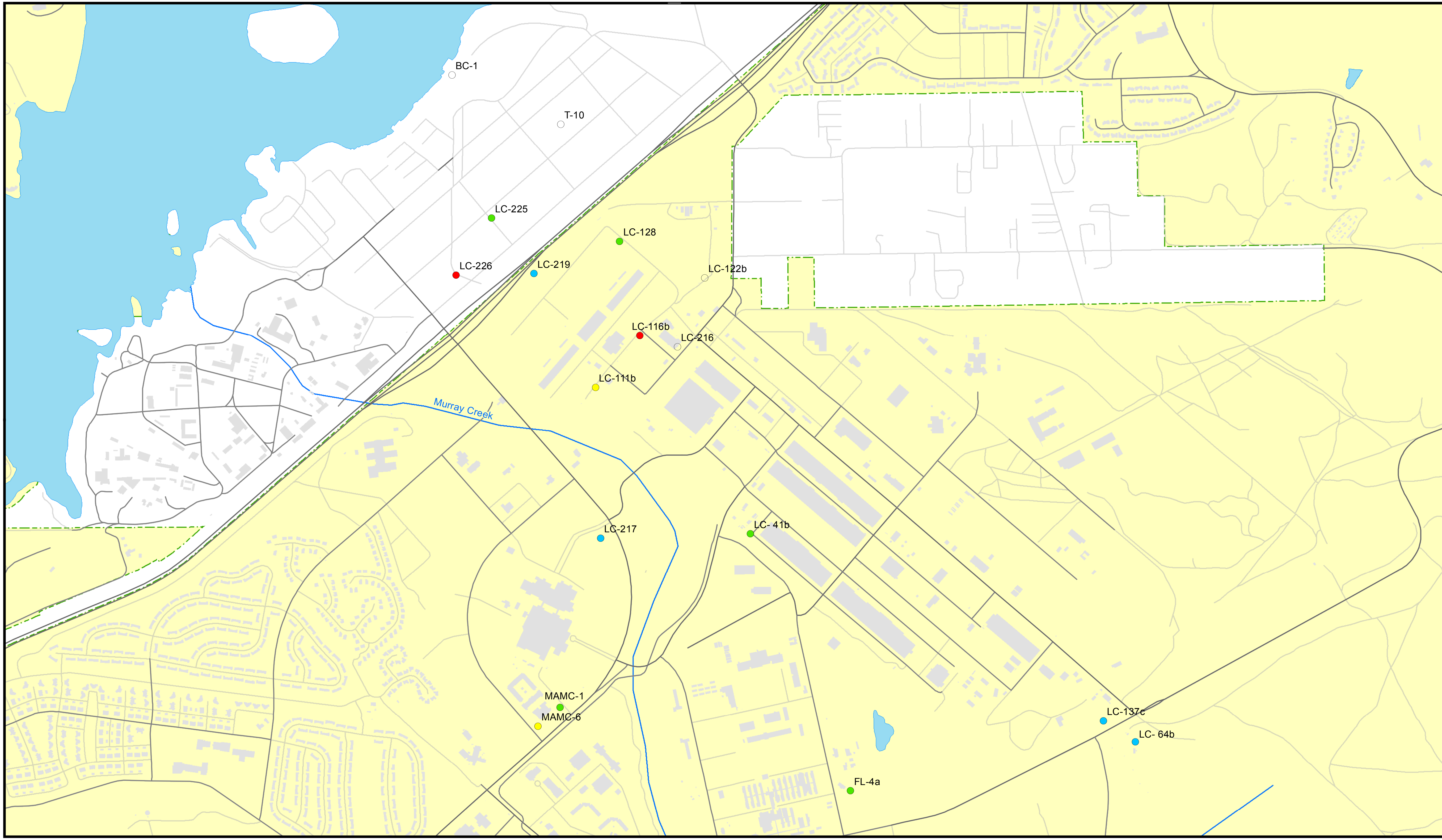
MAP DATA:
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

USACE

SEALASKA ENVIRONMENTAL

Figure 6-1
Upper Vashon Aquifer Current TCE Concentration Trends 2006-2015

Path: E:\JBLM\TO 01A\Logistics Center\LogRAM_2015_Annual_Report\MXD\LOGRAM_GWMRpt_2015-FIG_6-1_UVA_Trend.mxd
Date: 3/2/2016



Legend

Sample Location and Trend Statistics

- Statistically Significant Upward Trend
- Not Statistically Significant Upward Trend
- Not Statistically Significant Downward Trend
- Statistically Significant Downward Trend
- Data Not Analyzed

N

0 500 1,000 2,000

Feet

1 inch = 1,125 feet

MAP DATA:
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

USACE

SEALASKA ENVIRONMENTAL

Figure 6-2
Lower Vashon Aquifer Current TCE Concentration Trends 2006-2015

Path: E:\JBLM\TO 01A\Logistics Center\LogRAM_2015_Annual_Report\MXD\LOGRAM_GWMRpt_2015-FIG_6-2_LVA_Trend.mxd
Date: 2/17/2016

Legend

Sample Location and Trend Statistics

- Statistically Significant Upward Trend
- Not Statistically Significant Upward Trend
- Not Statistically Significant Downward Trend
- Statistically Significant Downward Trend
- Data Not Analyzed

N

0 750 1,500 3,000

Feet

1 inch = 1,725 feet

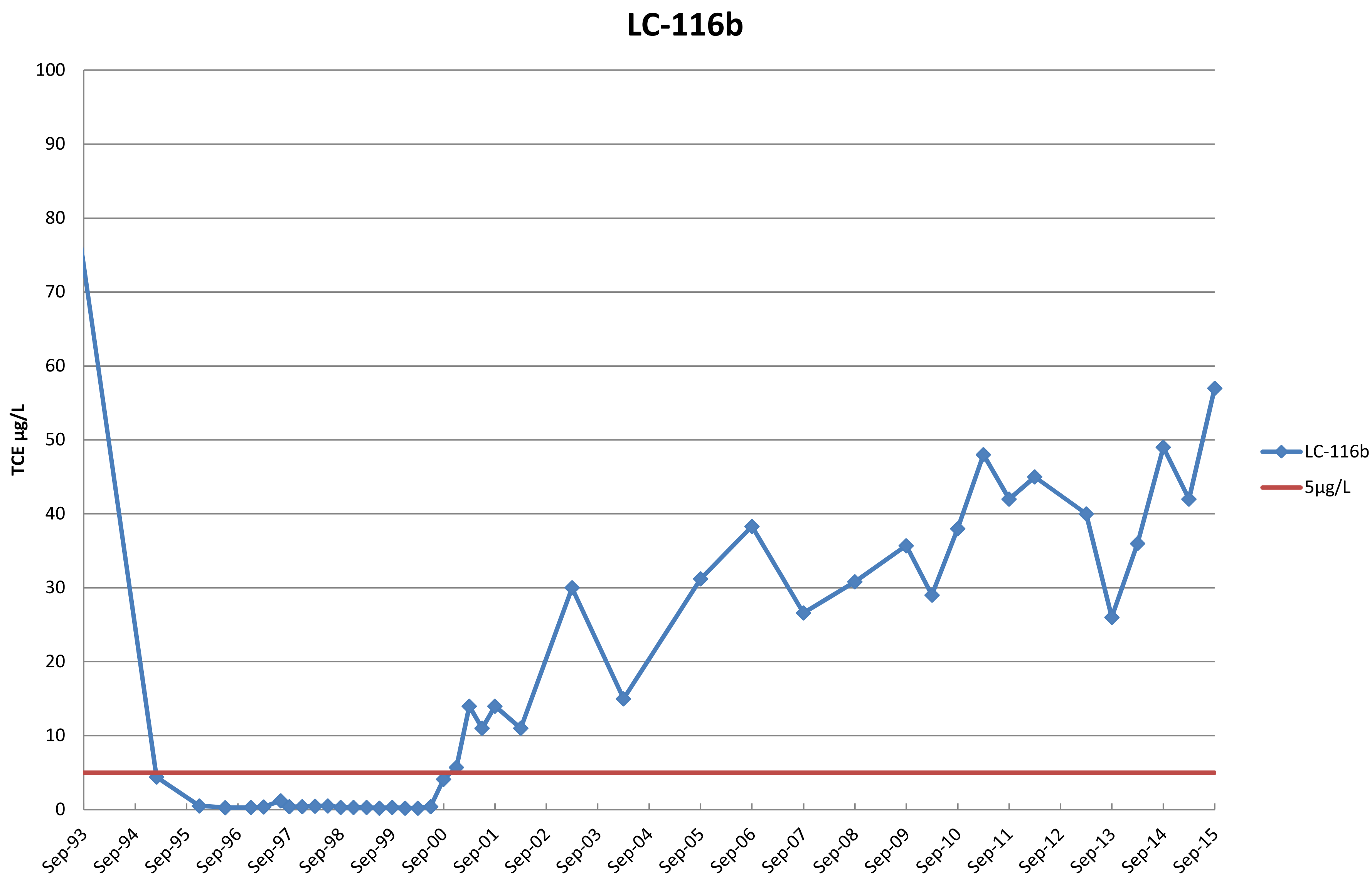
MAP DATA:
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

USACE

SEALASKA ENVIRONMENTAL

Figure 6-3
Sea Level Aquifer Current TCE Concentration Trends 2006-2015

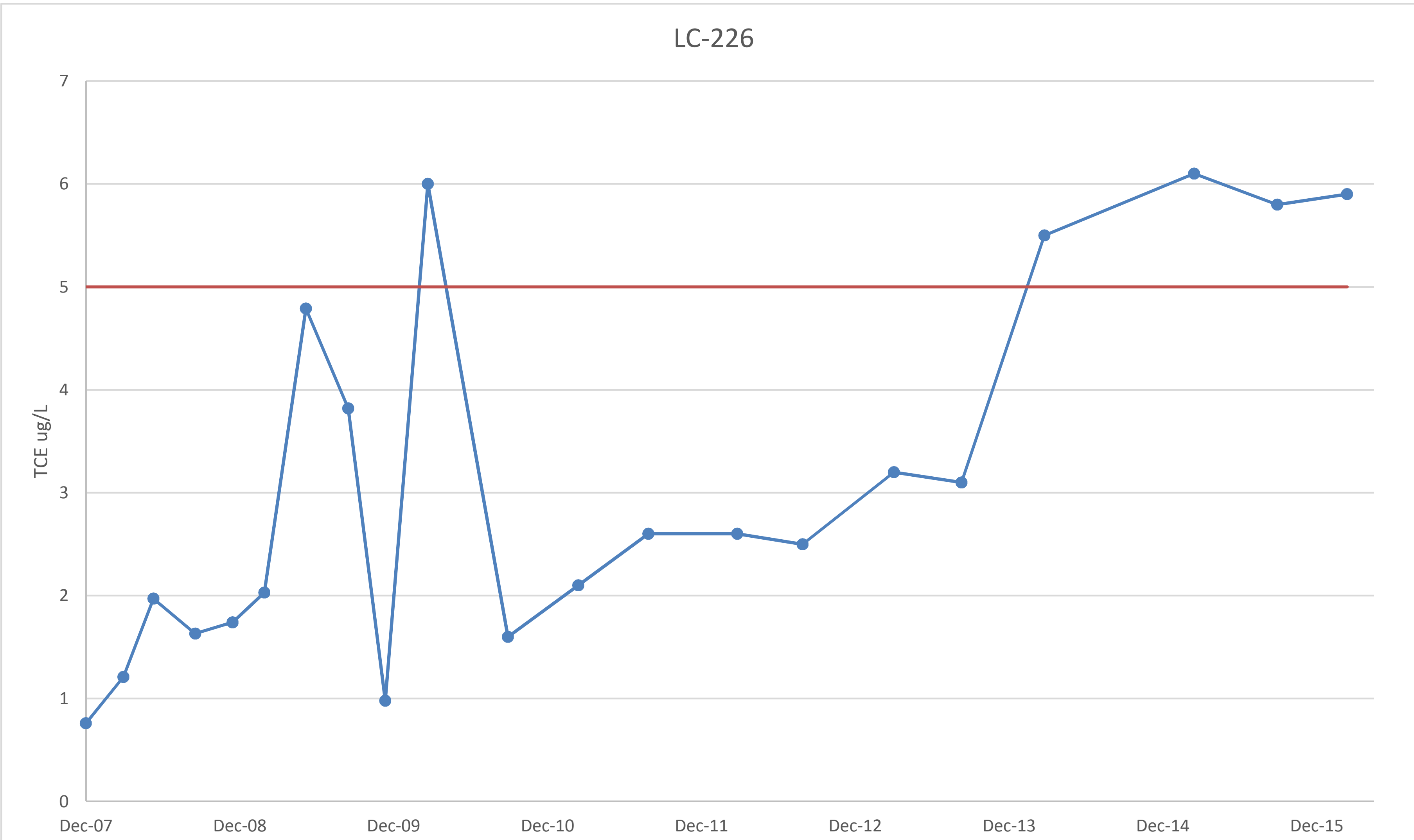
Path: E:\JBLM\TO 01A\Logistics Center\LogRAM_2015_Annual_Report\MXD\LOGRAM_GWMRpt_2015-FIG_6-3_SLA_Trend.mxd
Date: 2/24/2016

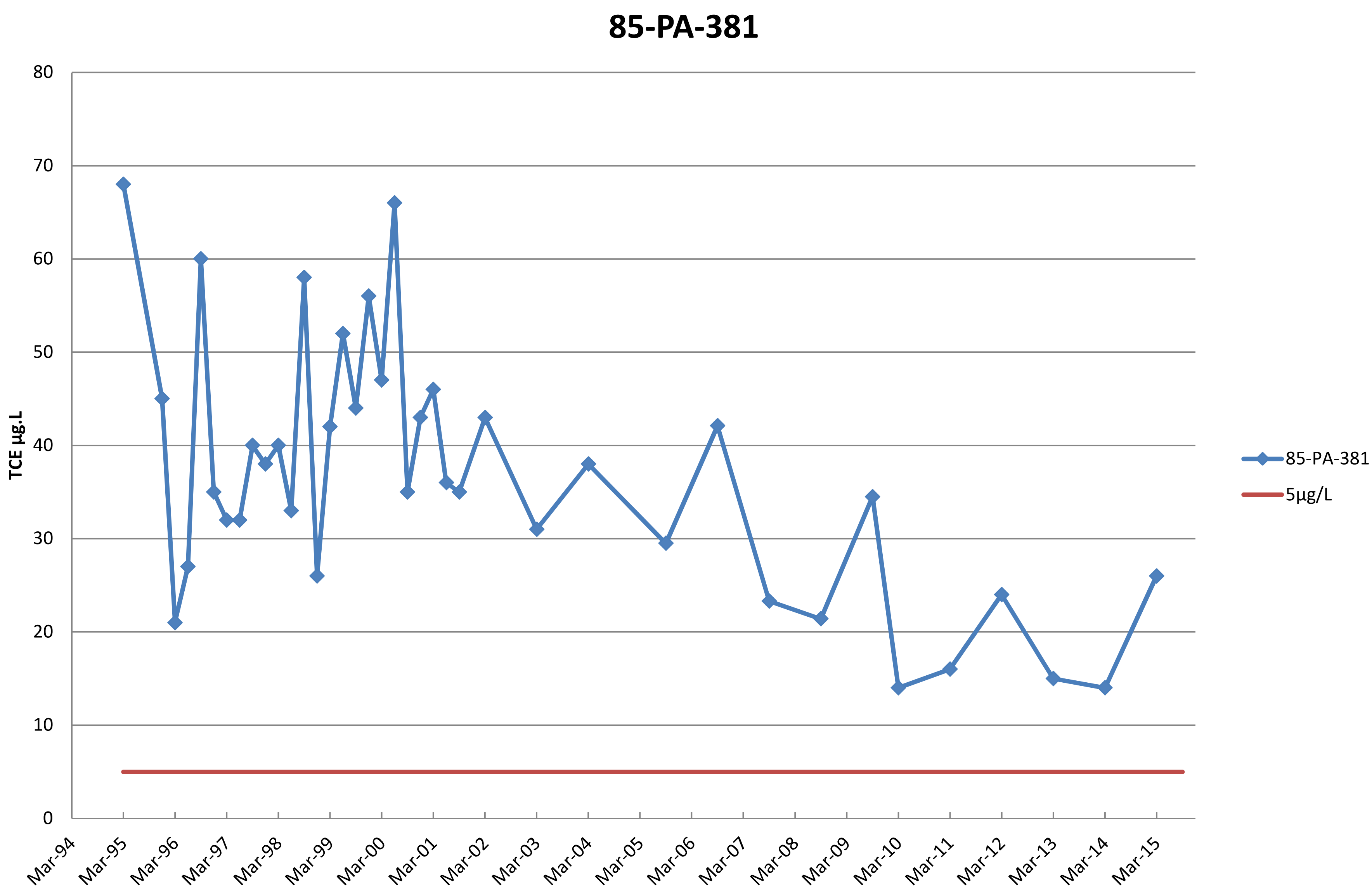

LC-116b
100
90
80
70
60
50
40
30
20
10
0
TCE µg/L
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-116b
5µg/L

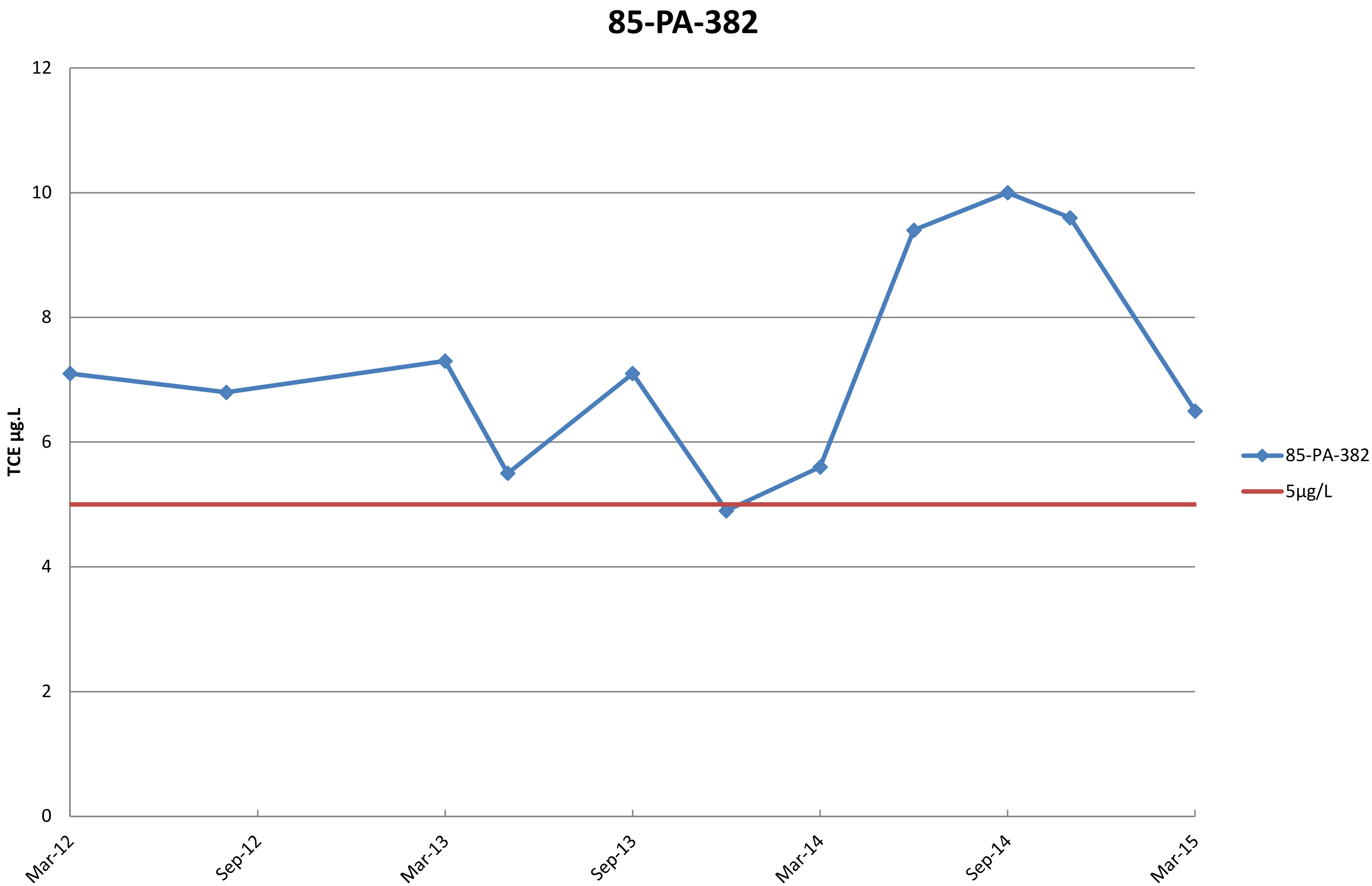
Appendix E - Historical Analytical Results and TCE Linear Graphs

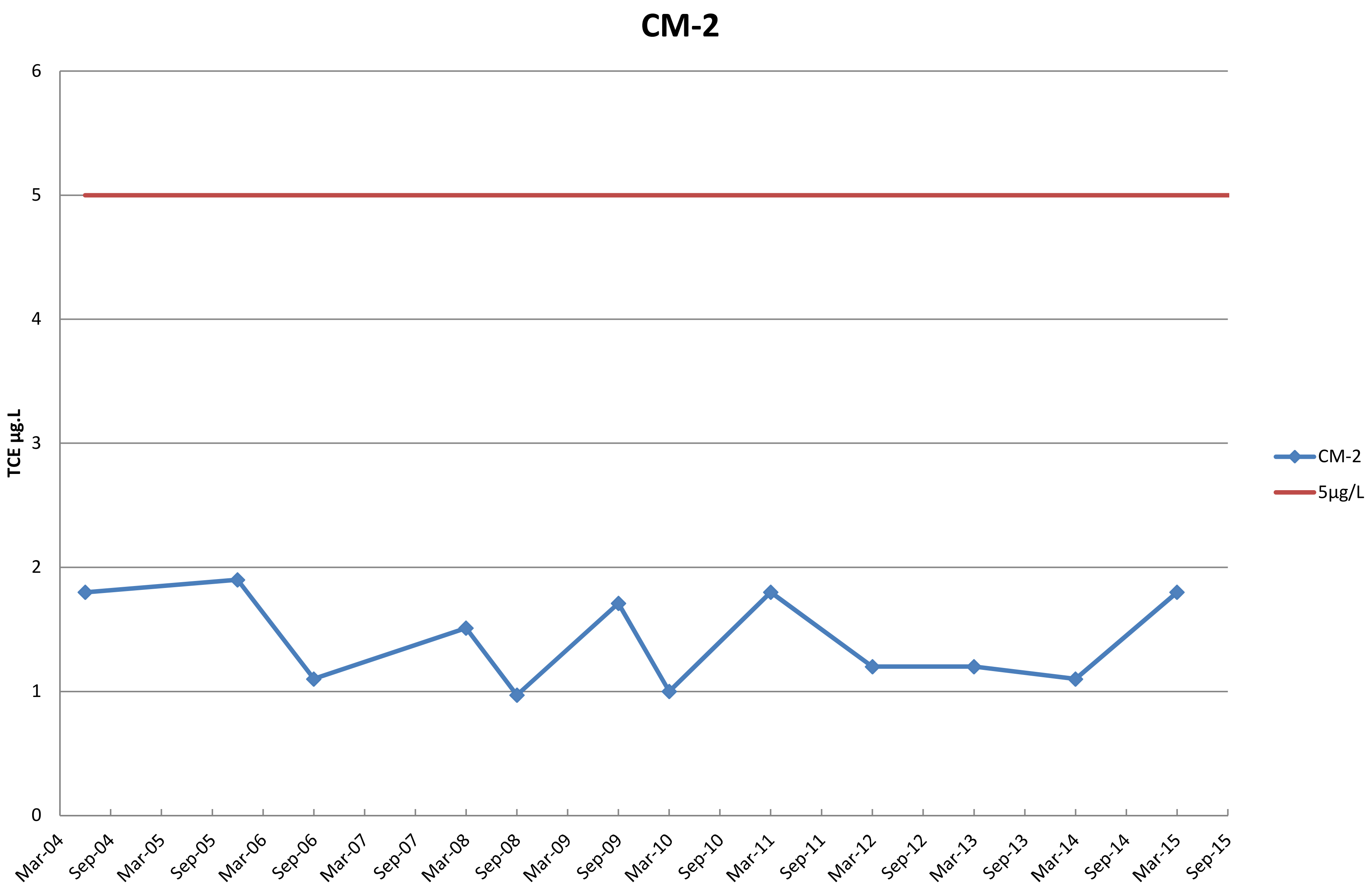
Lower Vashon Aquifer TCE Linear Graphs

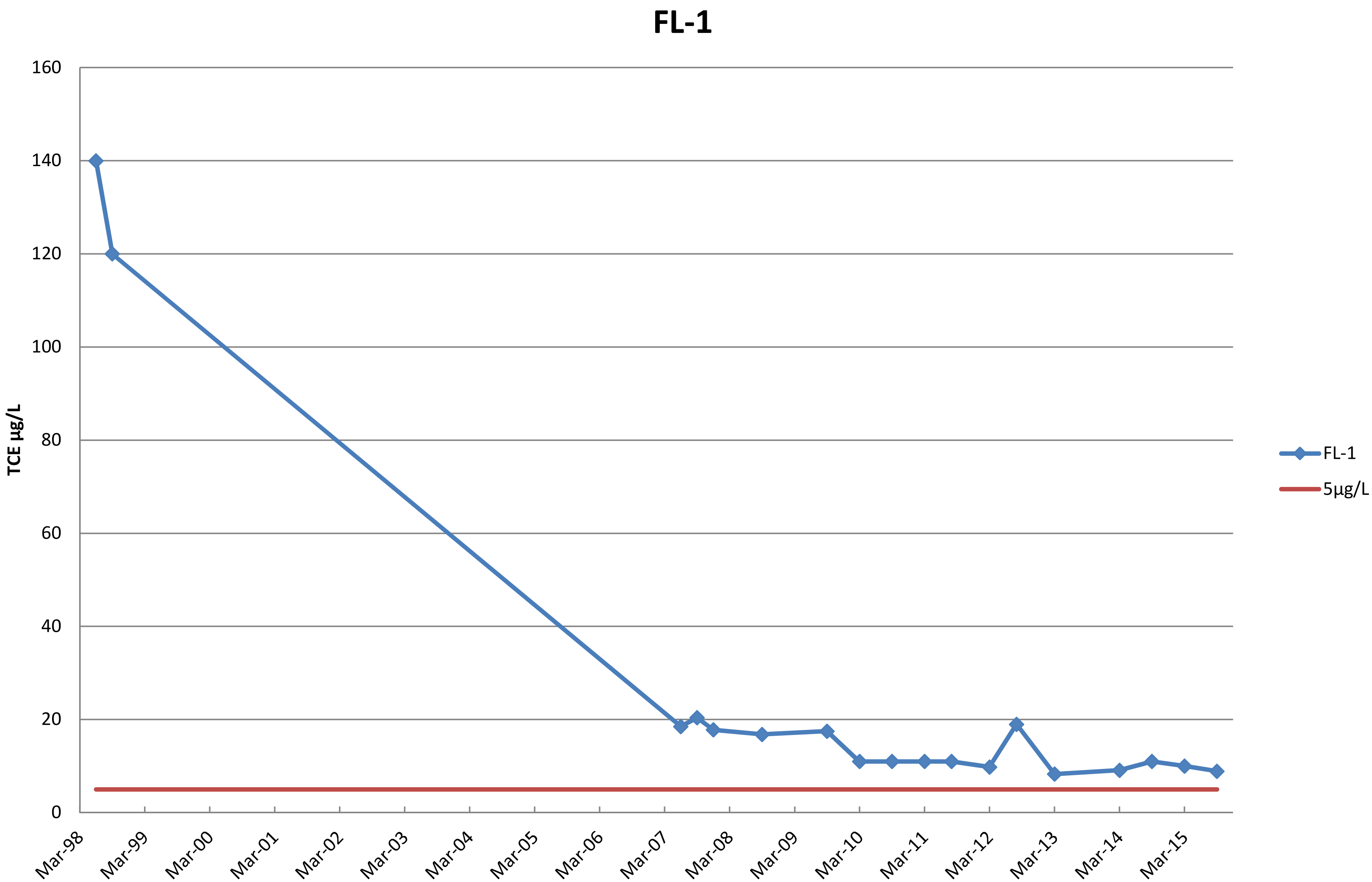
Log RAM - Joint Base Lewis McChord, Washington 98433

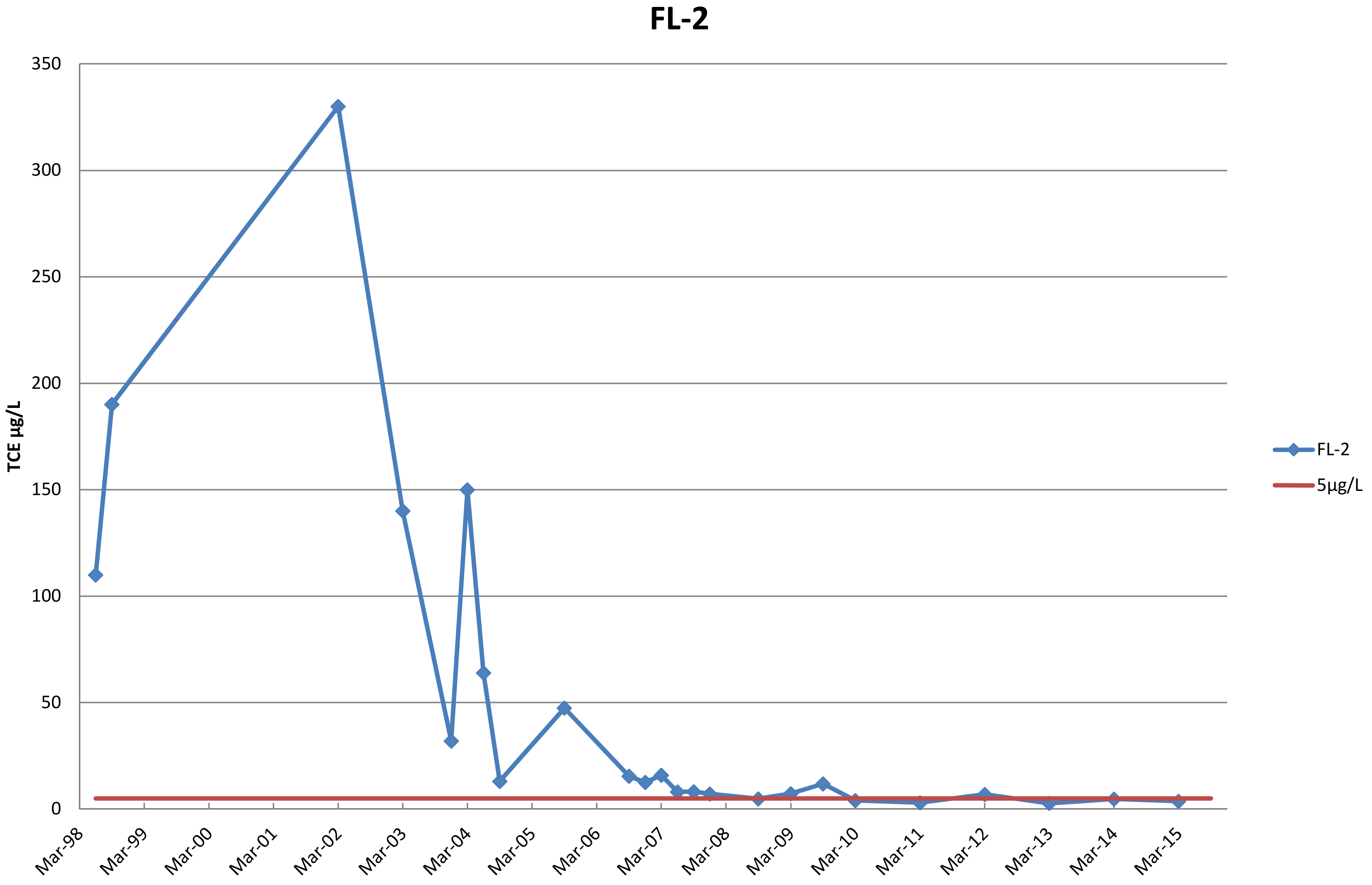


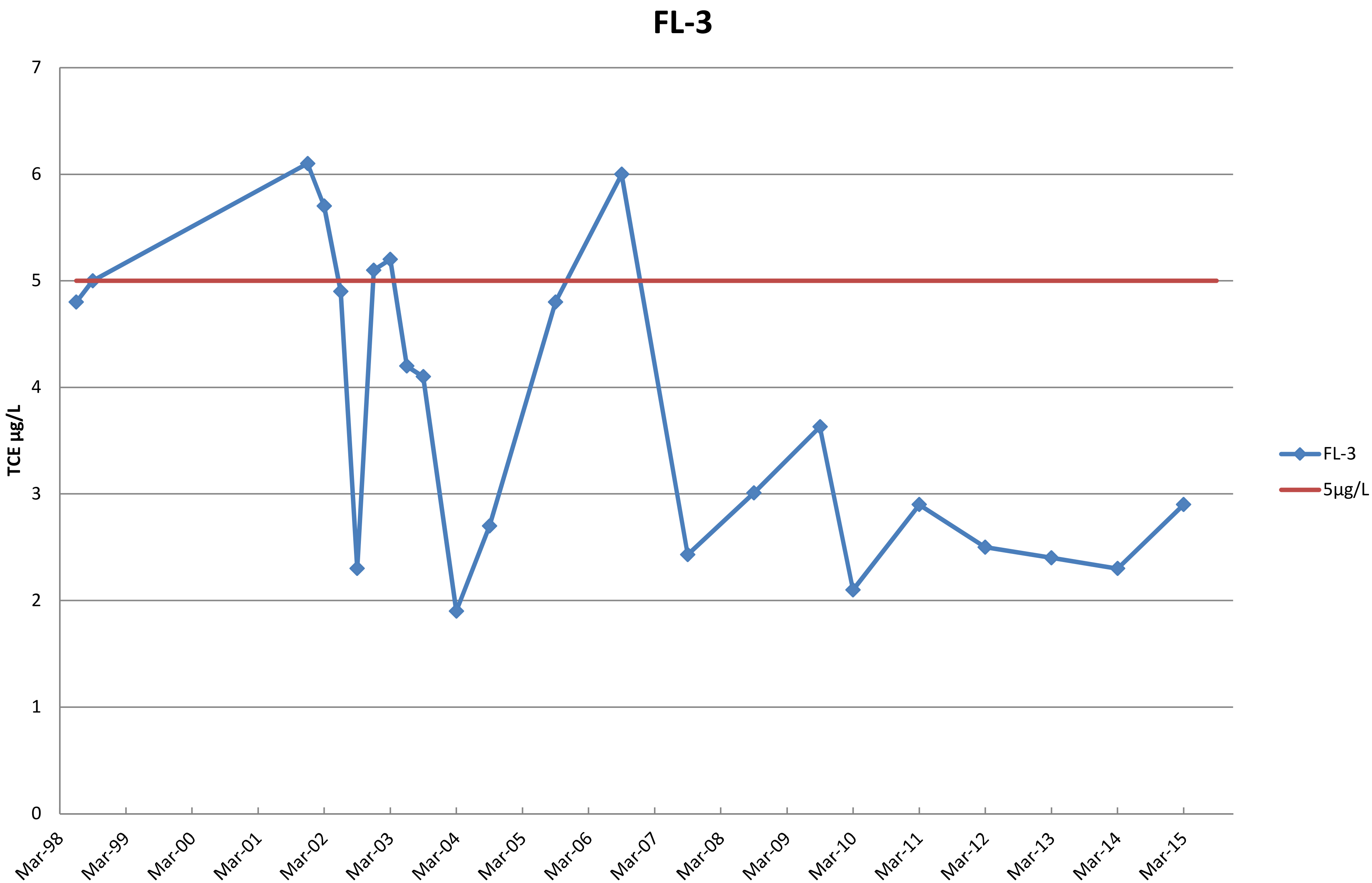

85-PA-381
TCE µg.L
80
70
60
50
40
30
20
10
0
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
85-PA-381
5µg/L

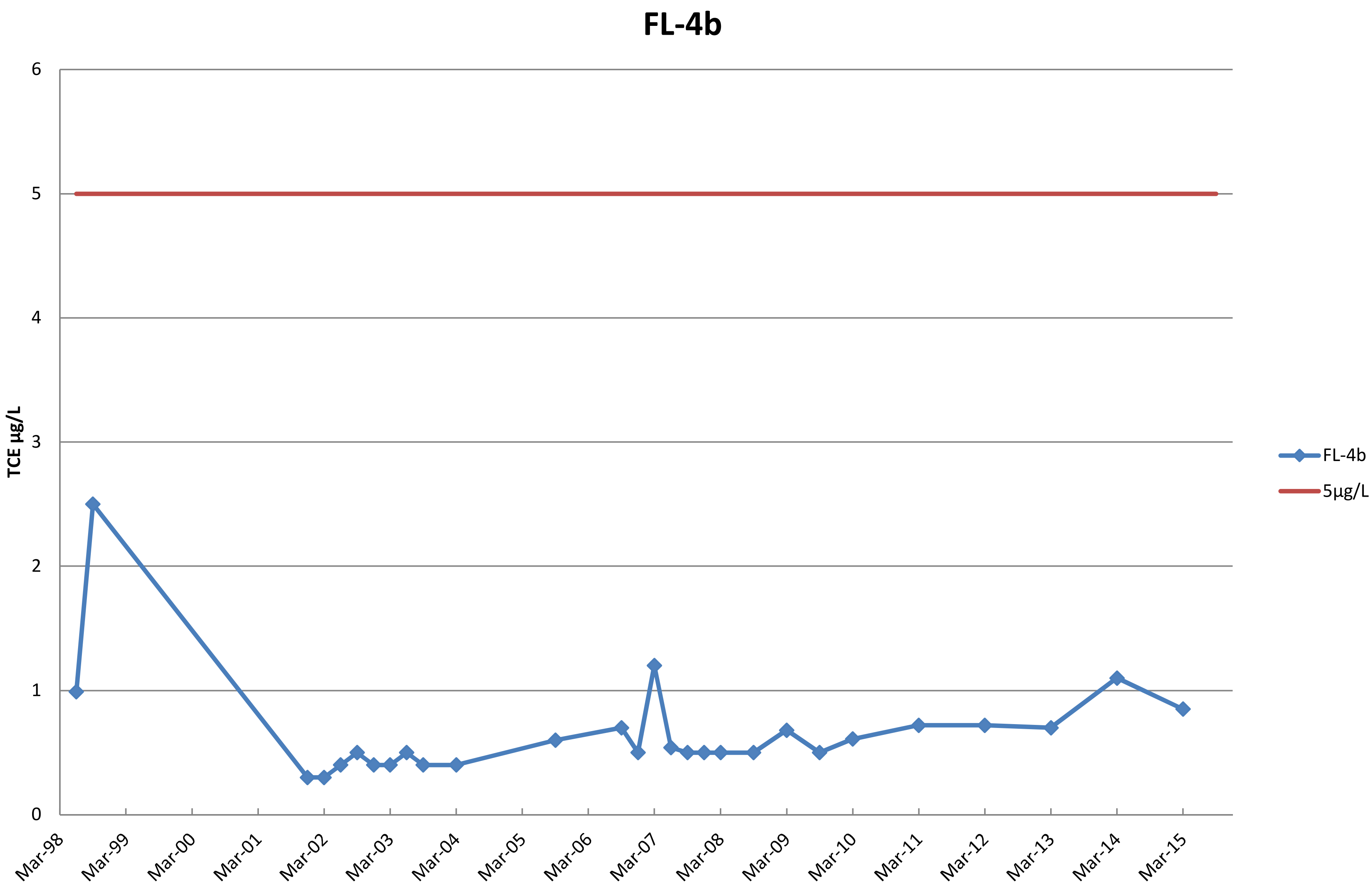

85-PA-382
12
10
8
6
4
2
0
TCE µg.L
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
85-PA-382
5µg/L

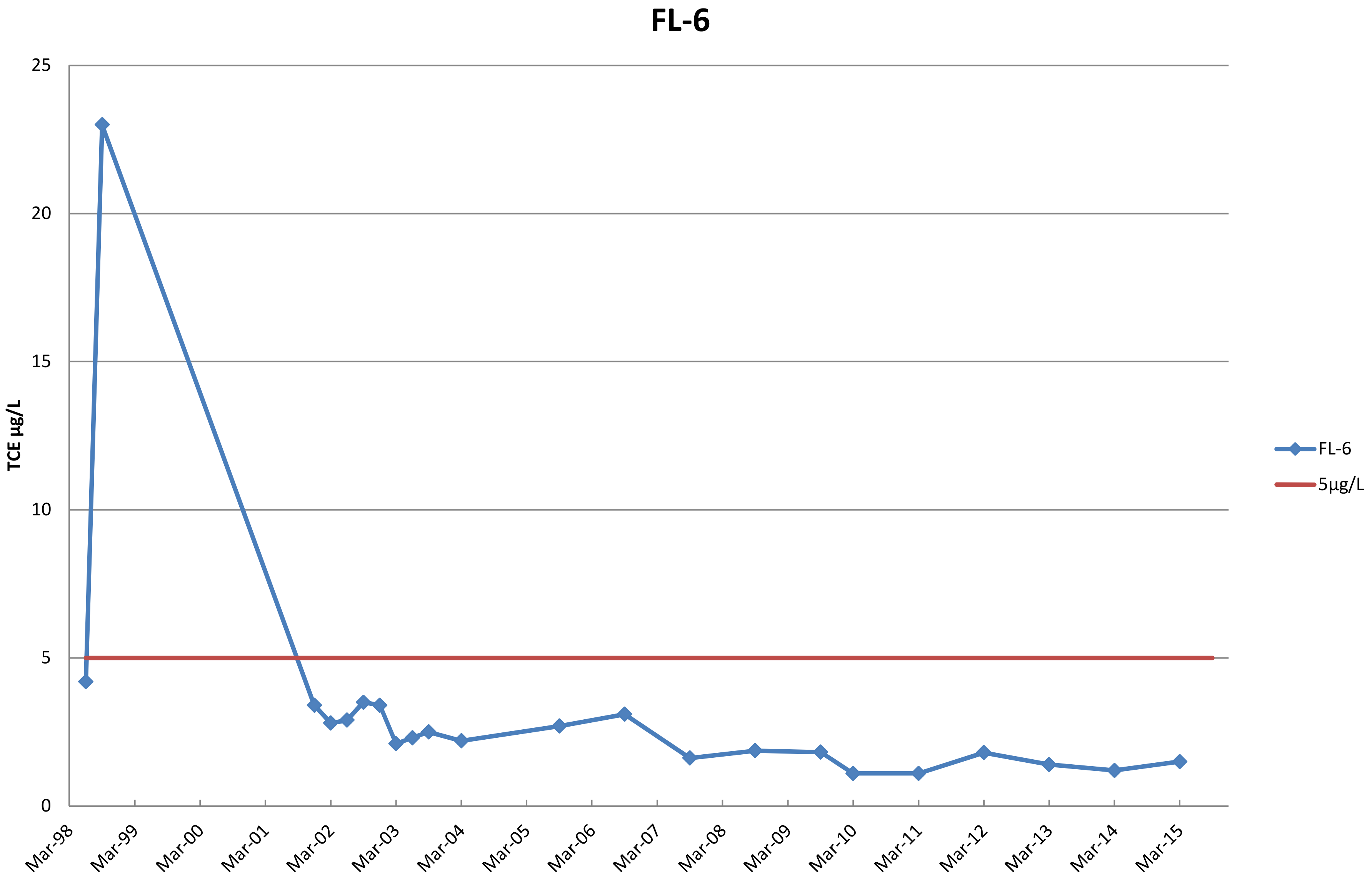

CM-2
TCE µg.L
6
5
4
3
2
1
0
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
CM-2
5µg/L

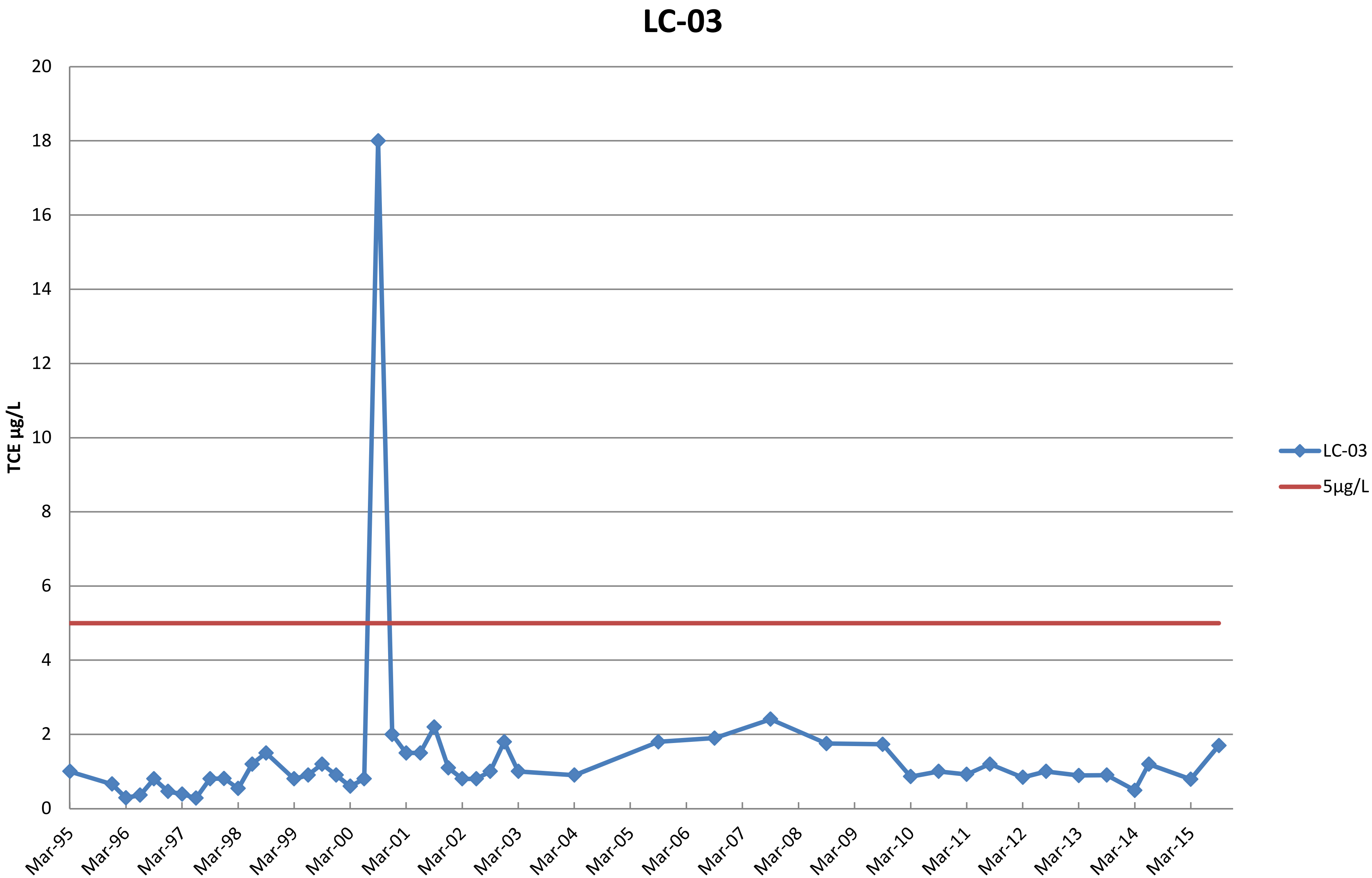

FL-1
TCE µg/L
160
140
120
100
80
60
40
20
0
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
FL-1
5µg/L

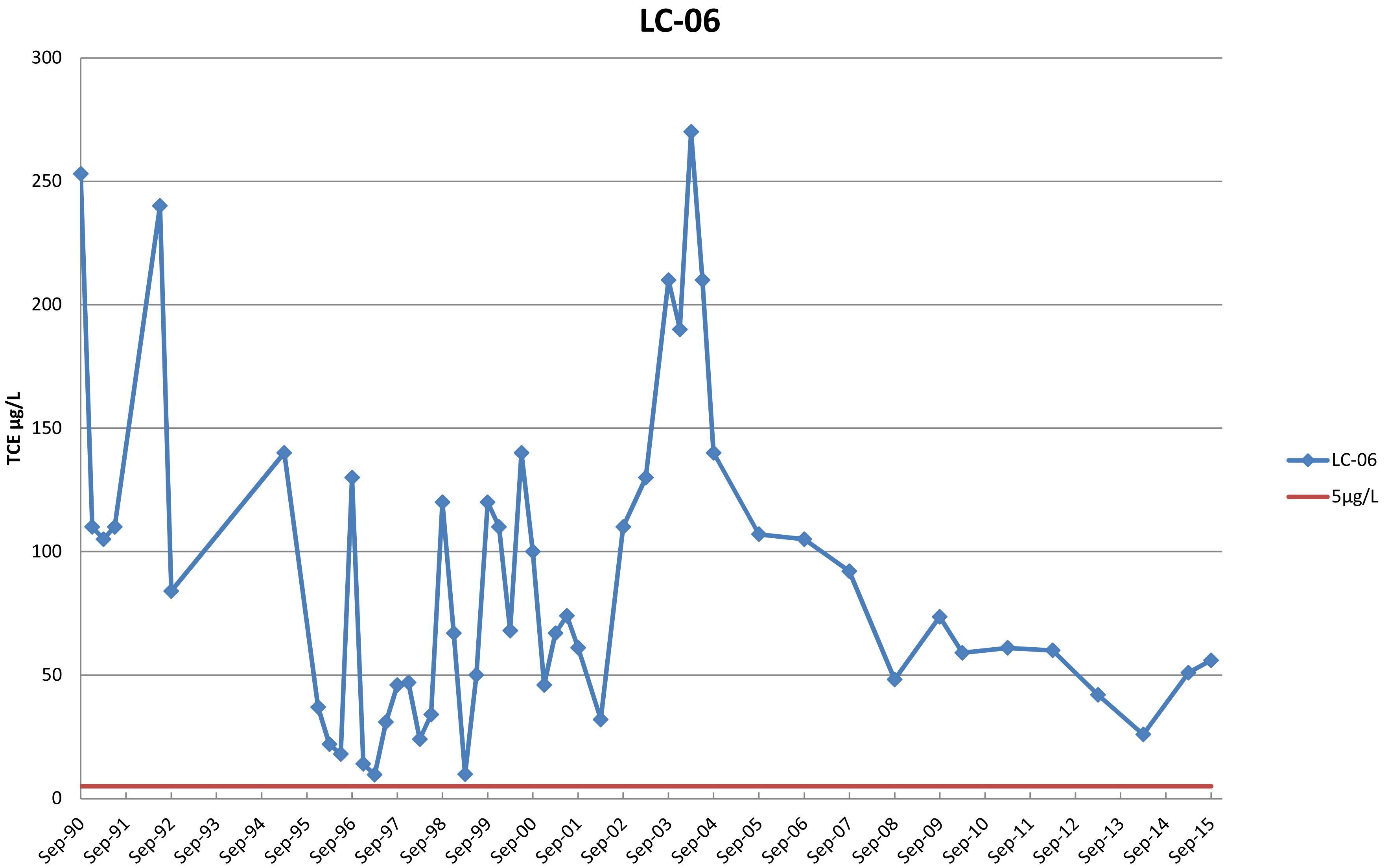

FL-2
TCE µg/L
350
300
250
200
150
100
50
0
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
FL-2
5µg/L

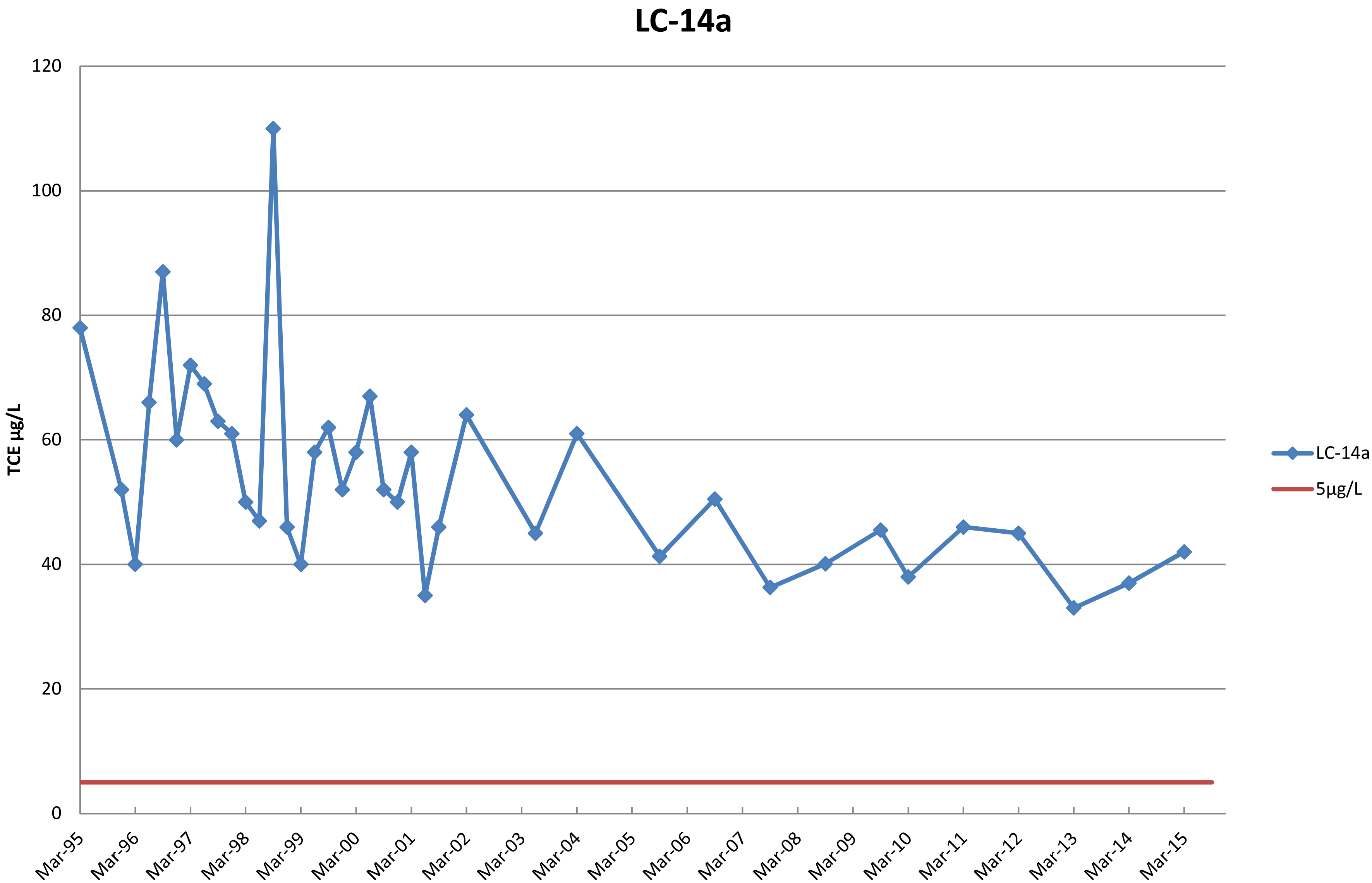

FL-3
TCE µg/L
0
1
2
3
4
5
6
7
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
FL-3
5µg/L

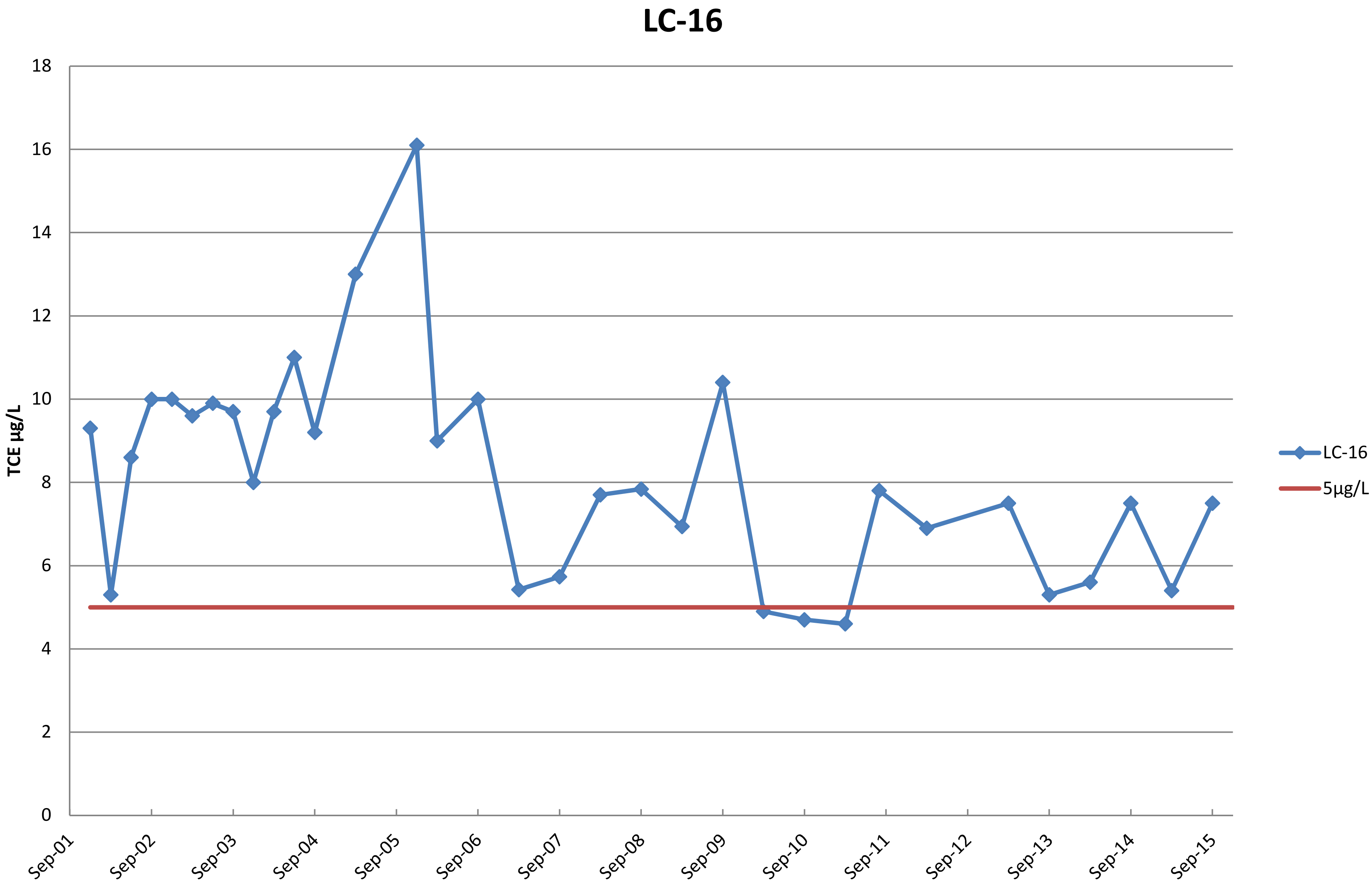

FL-4b
TCE µg/L
6
5
4
3
2
1
0
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
FL-4b
5µg/L

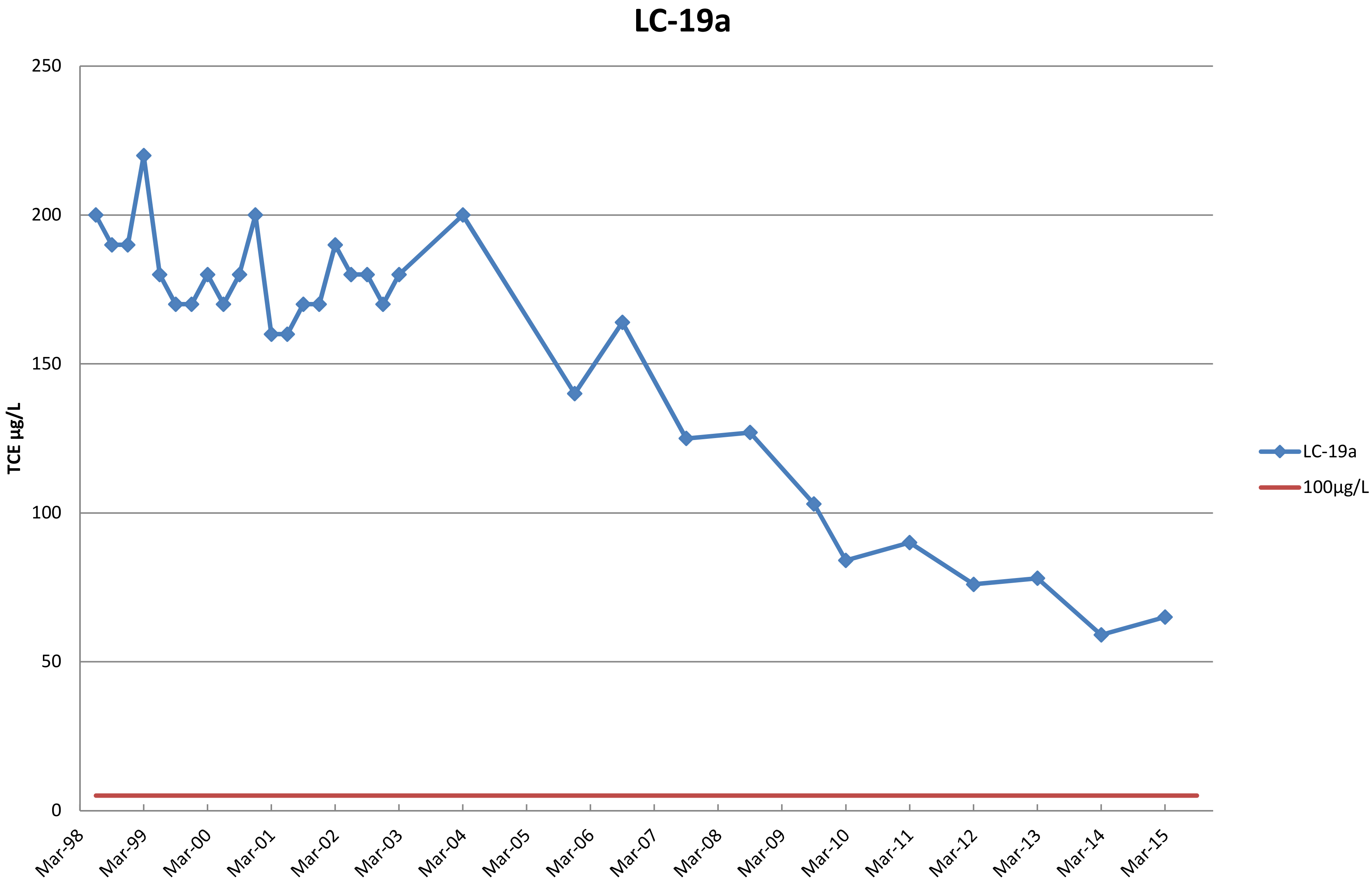

FL-6
25
20
15
10
5
0
TCE µg/L
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
FL-6
5µg/L

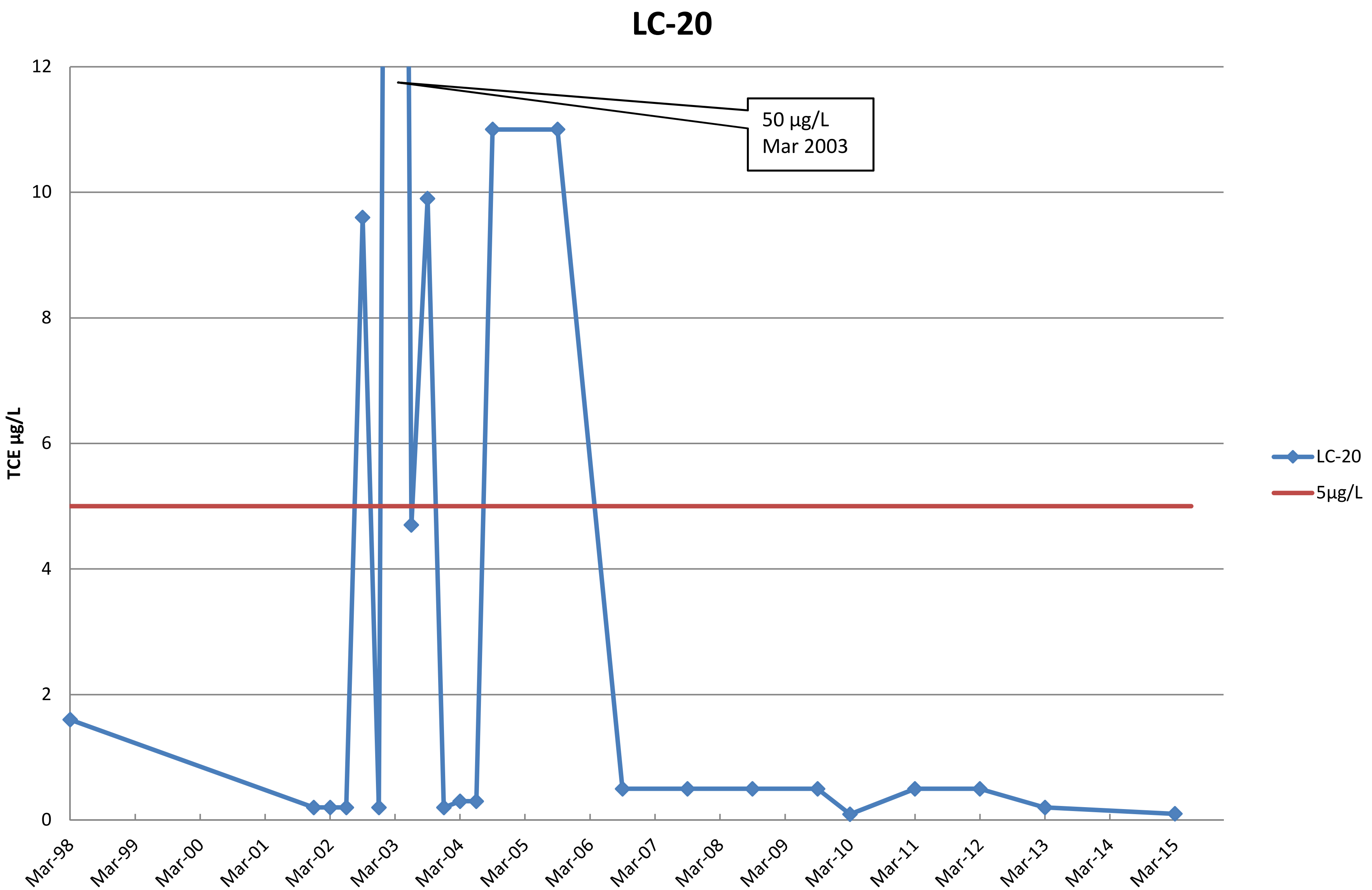

LC-03
TCE µg/L
0
2
4
6
8
10
12
14
16
18
20
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
LC-03
5µg/L

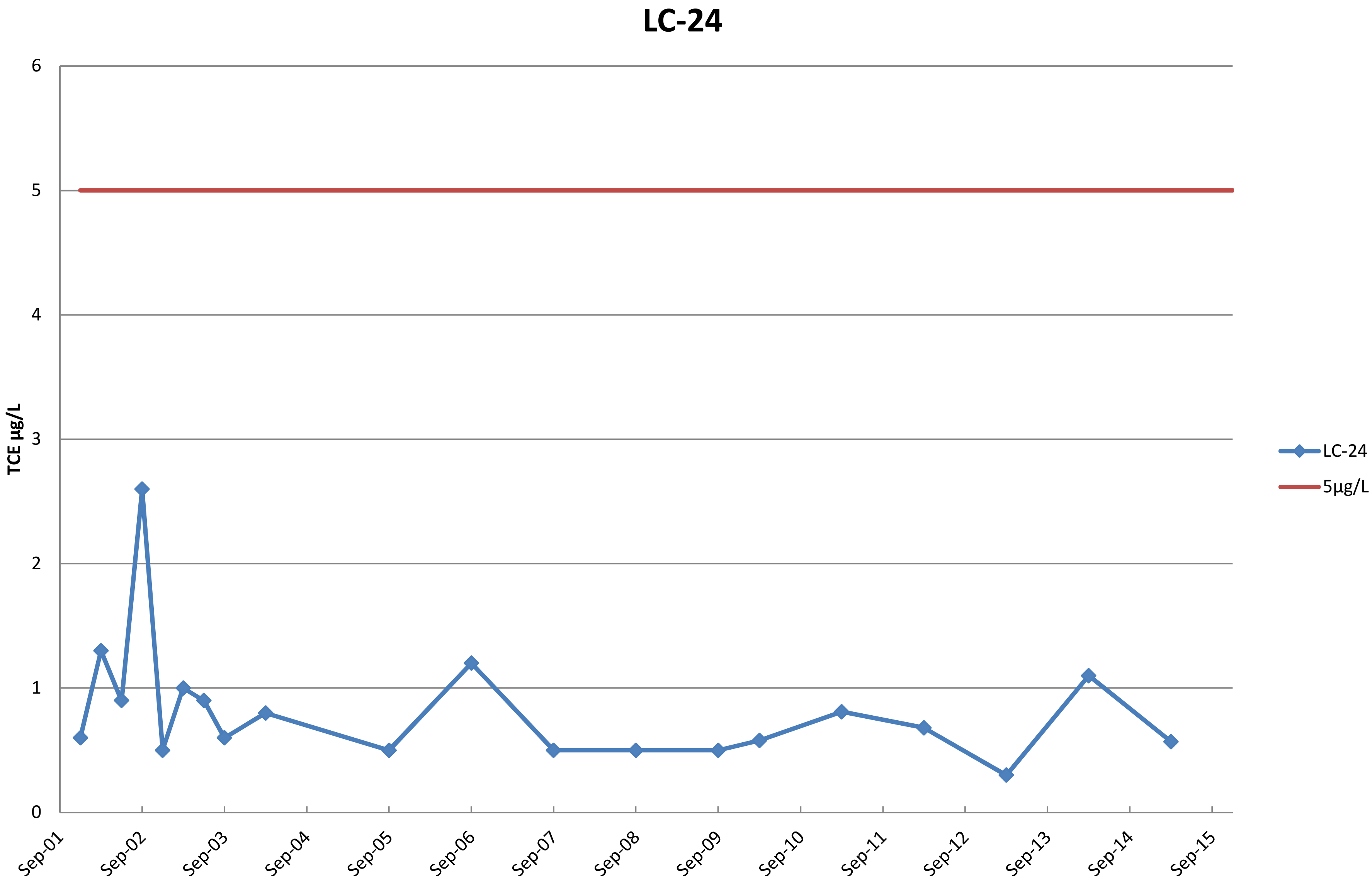

LC-06
TCE µg/L
300
250
200
150
100
50
0
Sep-90
Sep-91
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-06
5µg/L

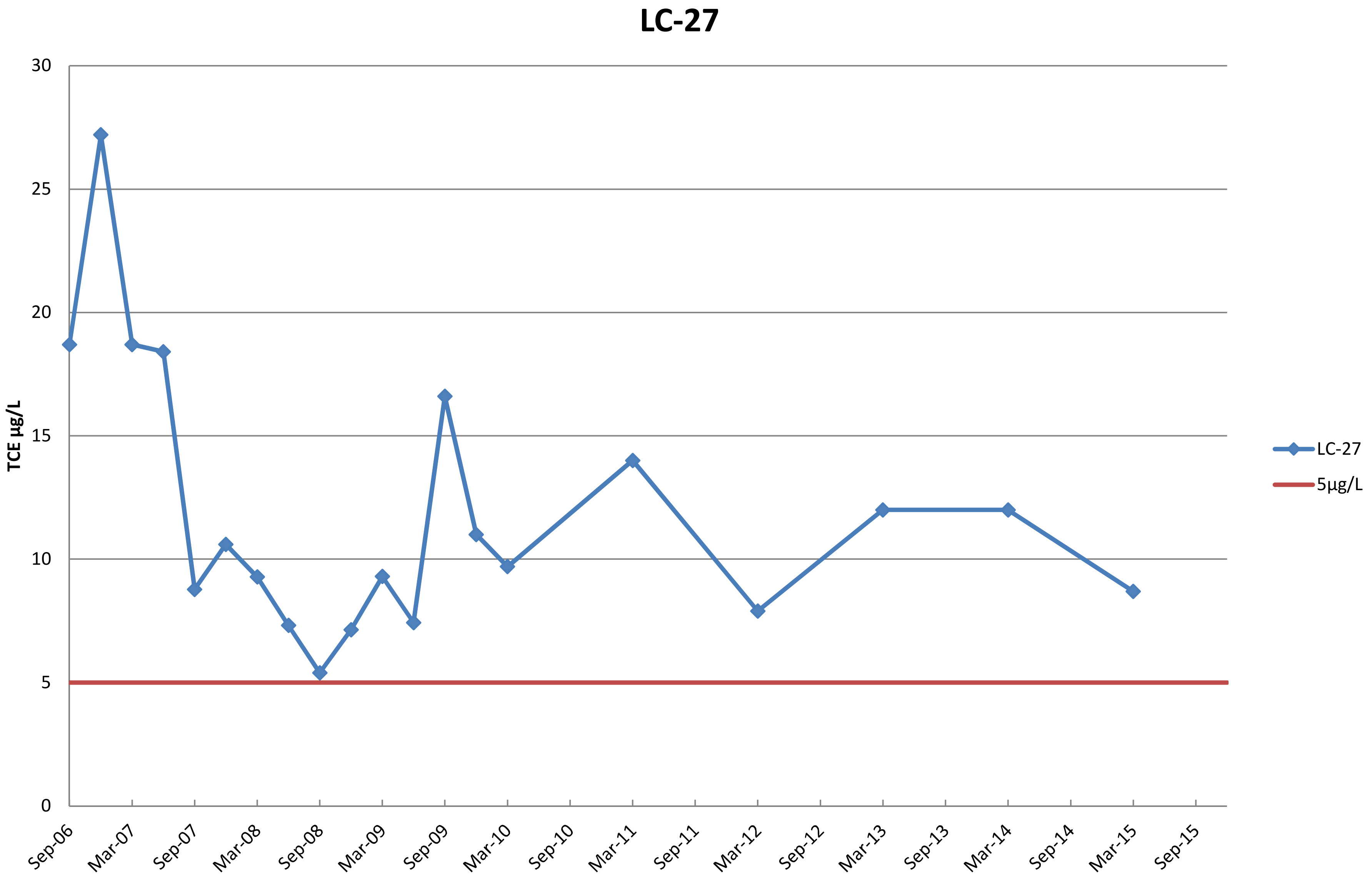

LC-14a
TCE µg/L
0
20
40
60
80
100
120
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
LC-14a
5µg/L

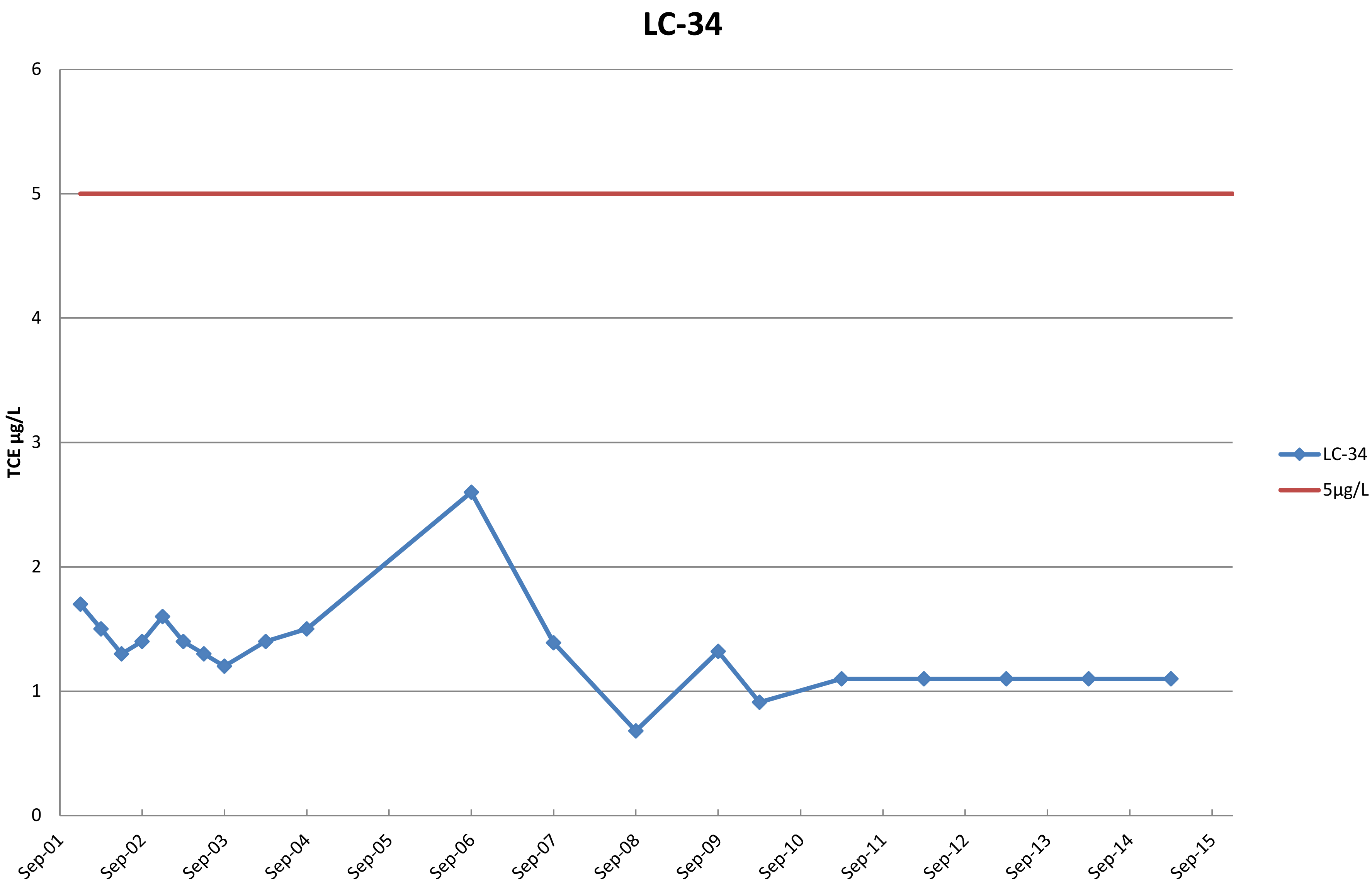

LC-16
TCE µg/L
18
16
14
12
10
8
6
4
2
0
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-16
5µg/L

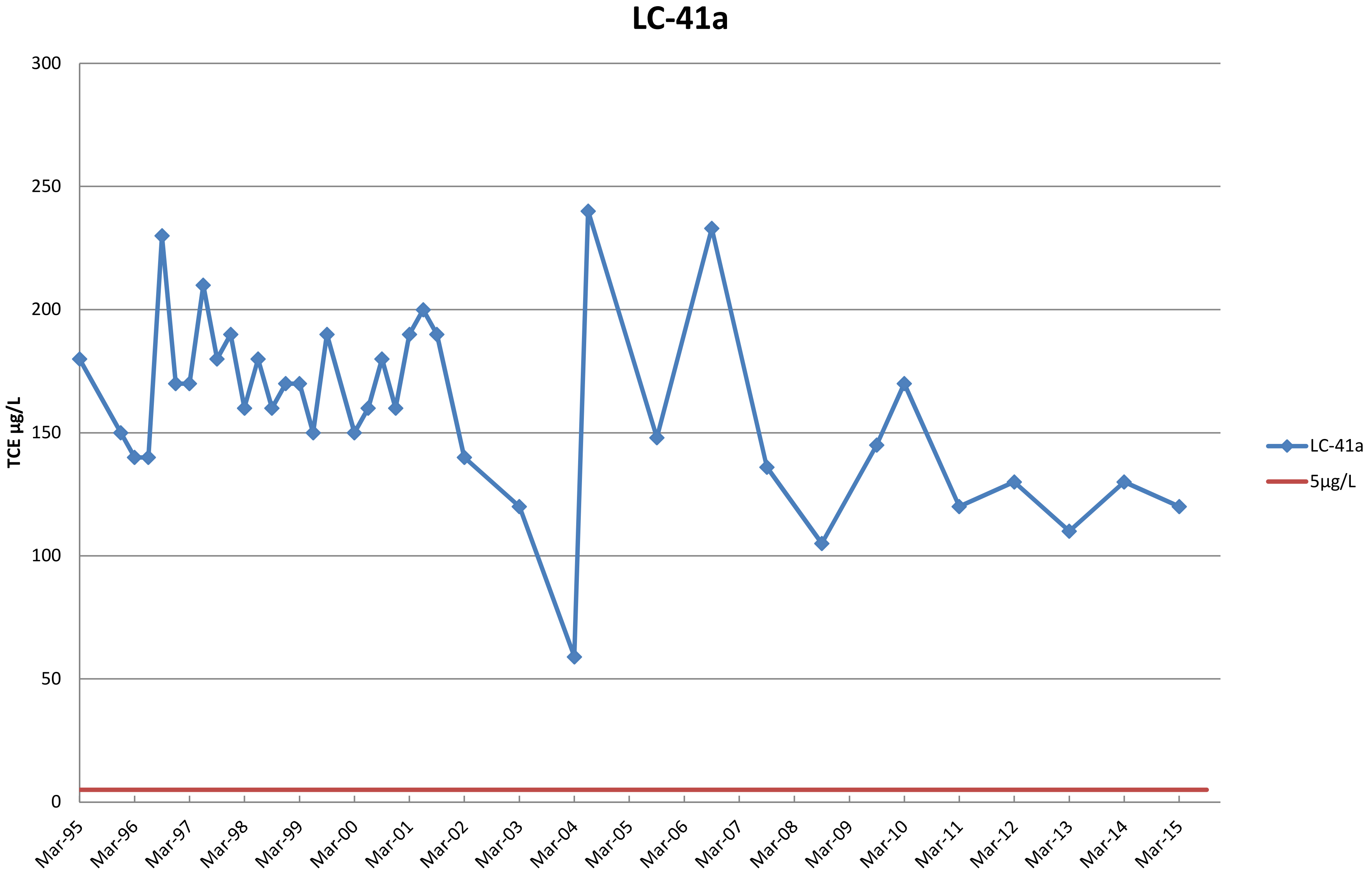

LC-19a
250
200
150
100
50
0
TCE µg/L
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
LC-19a
100µg/L

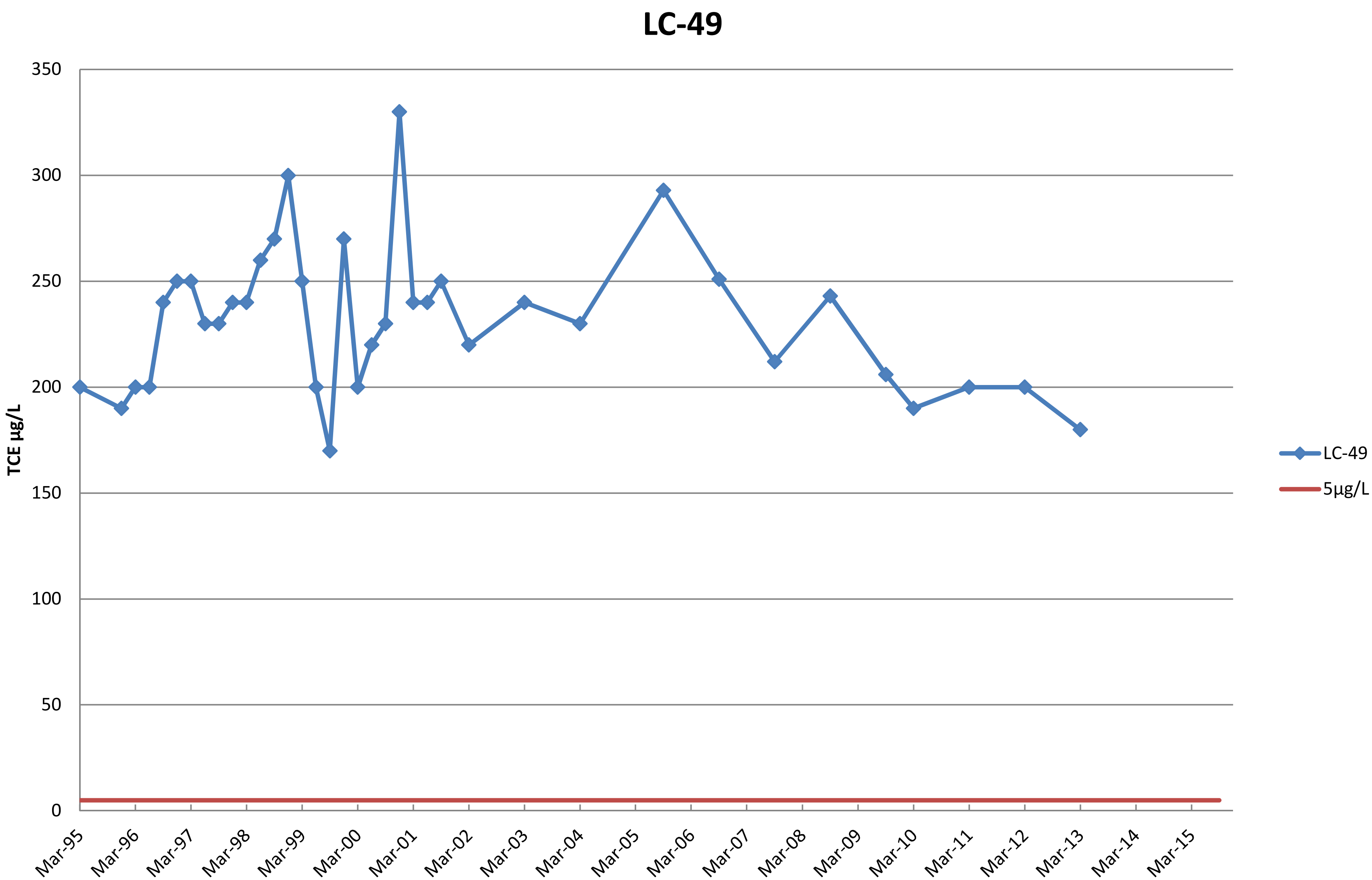

LC-20
TCE µg/L
12
10
8
6
4
2
0
50 µg/L
Mar 2003
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
LC-20
5µg/L

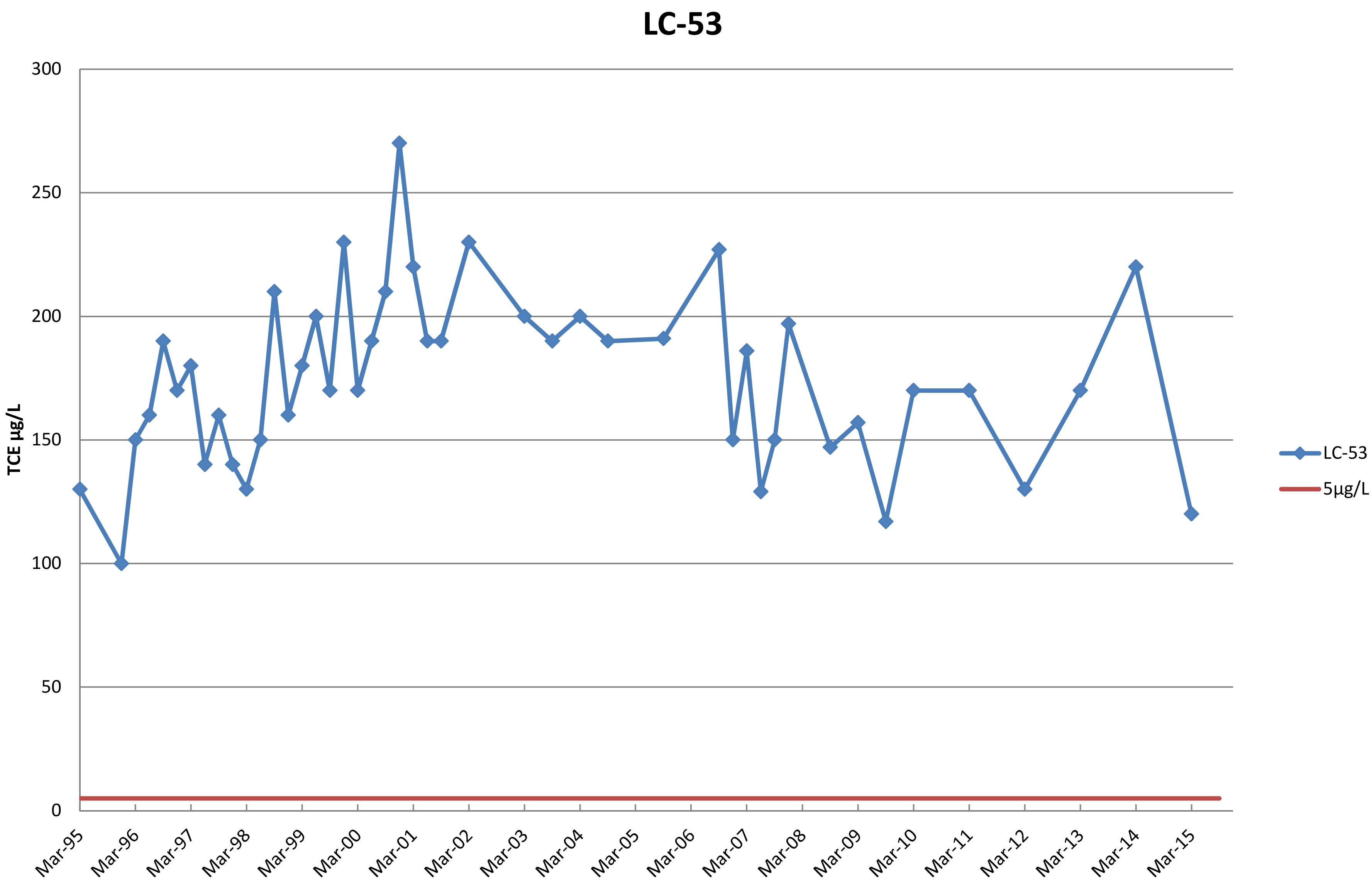

LC-24
TCE µg/L
0
1
2
3
4
5
6
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-24
5µg/L

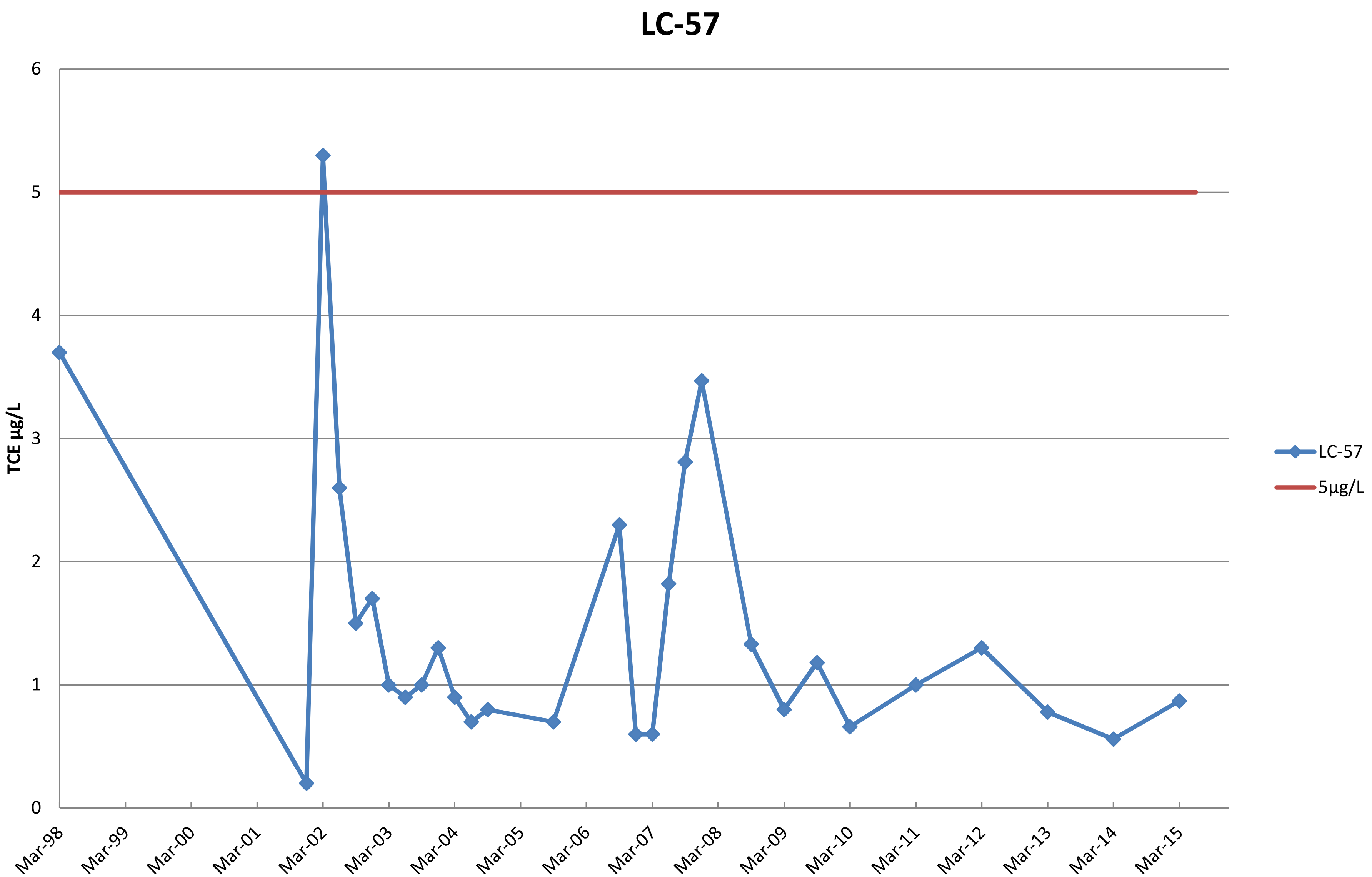

LC-27
TCE µg/L
30
25
20
15
10
5
0
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-27
5µg/L

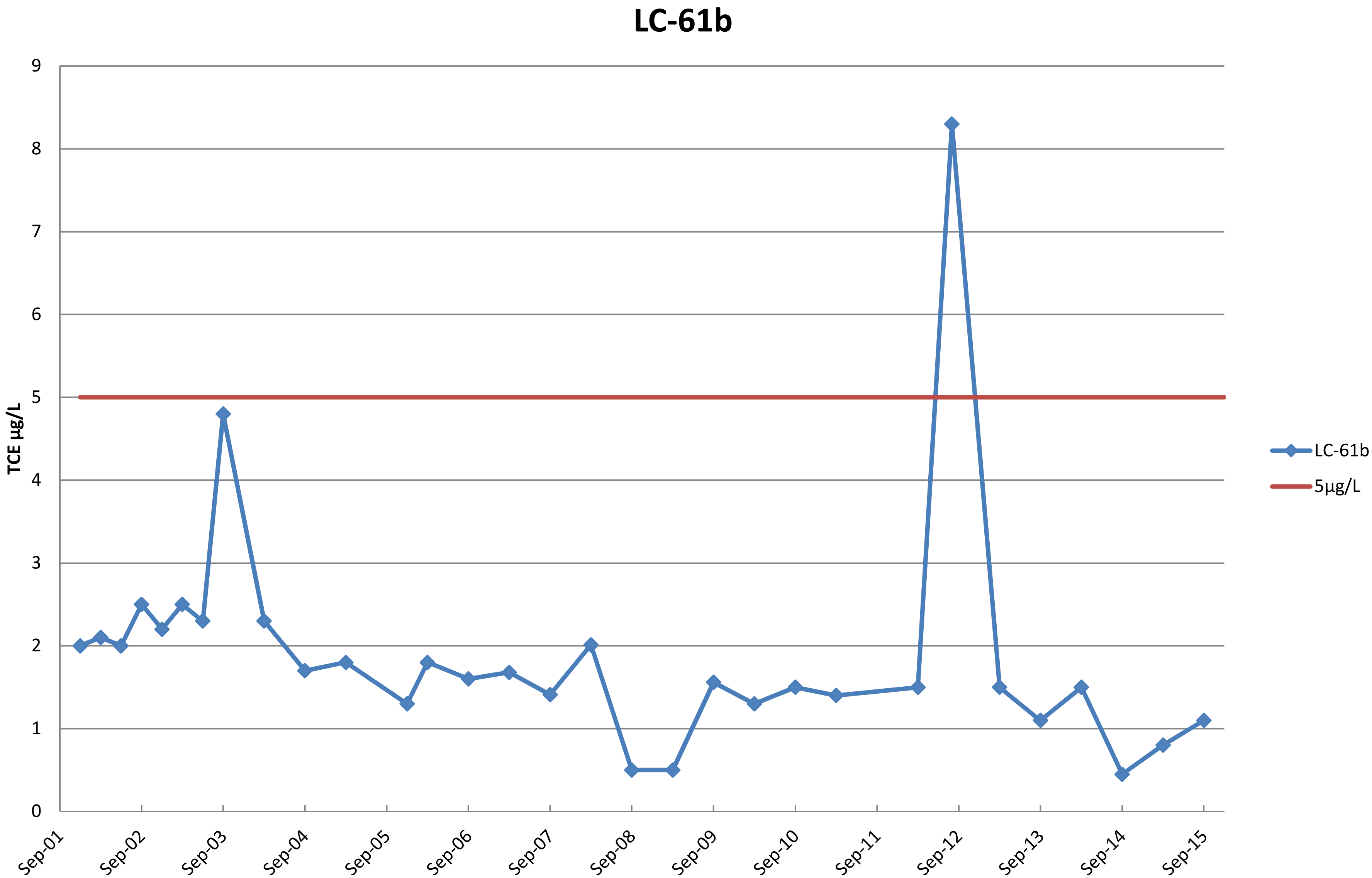

LC-34
6
5
4
3
2
1
0
TCE µg/L
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-34
5µg/L

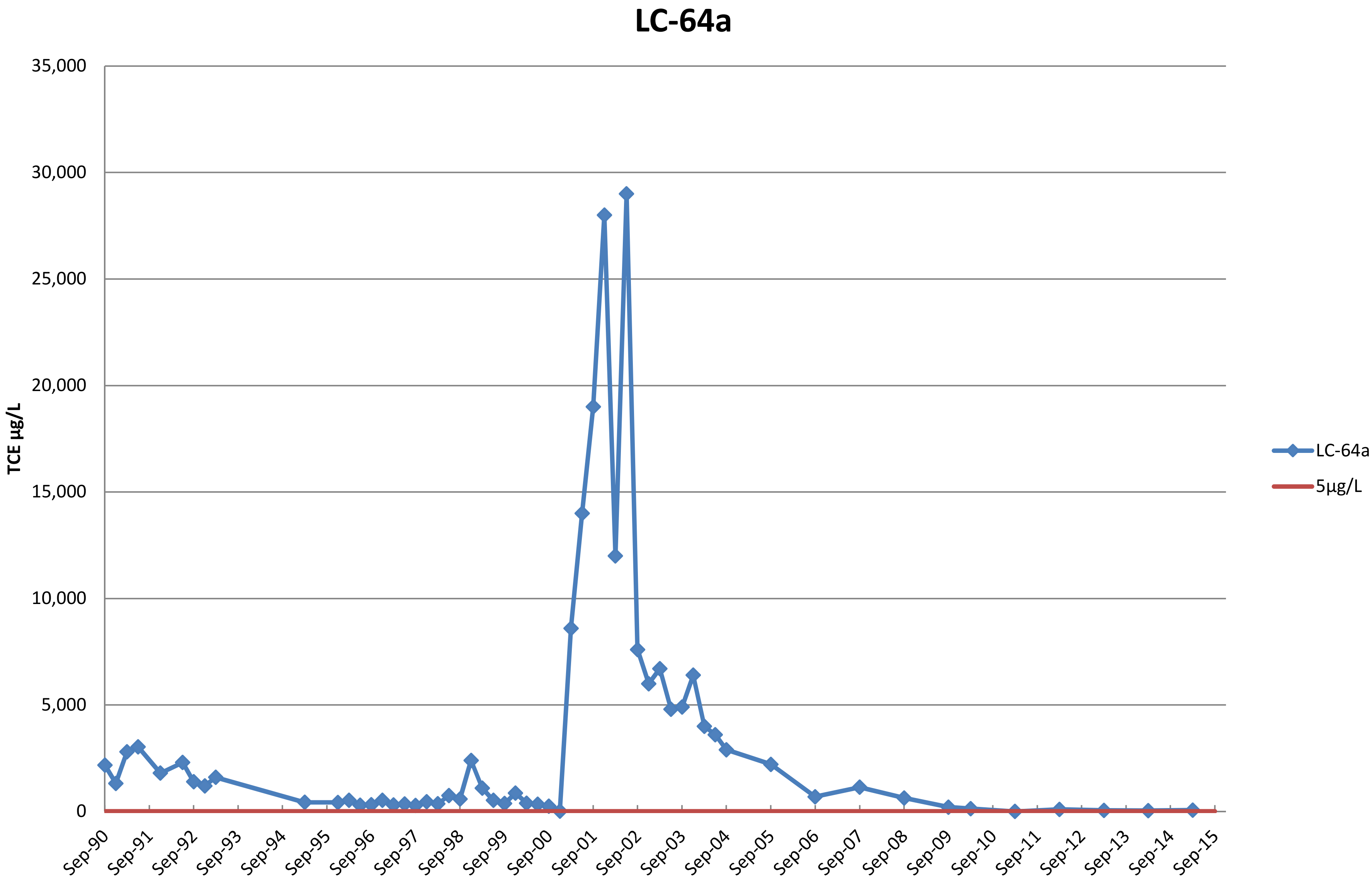

LC-41a
TCE µg/L
300
250
200
150
100
50
0
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
LC-41a
5µg/L

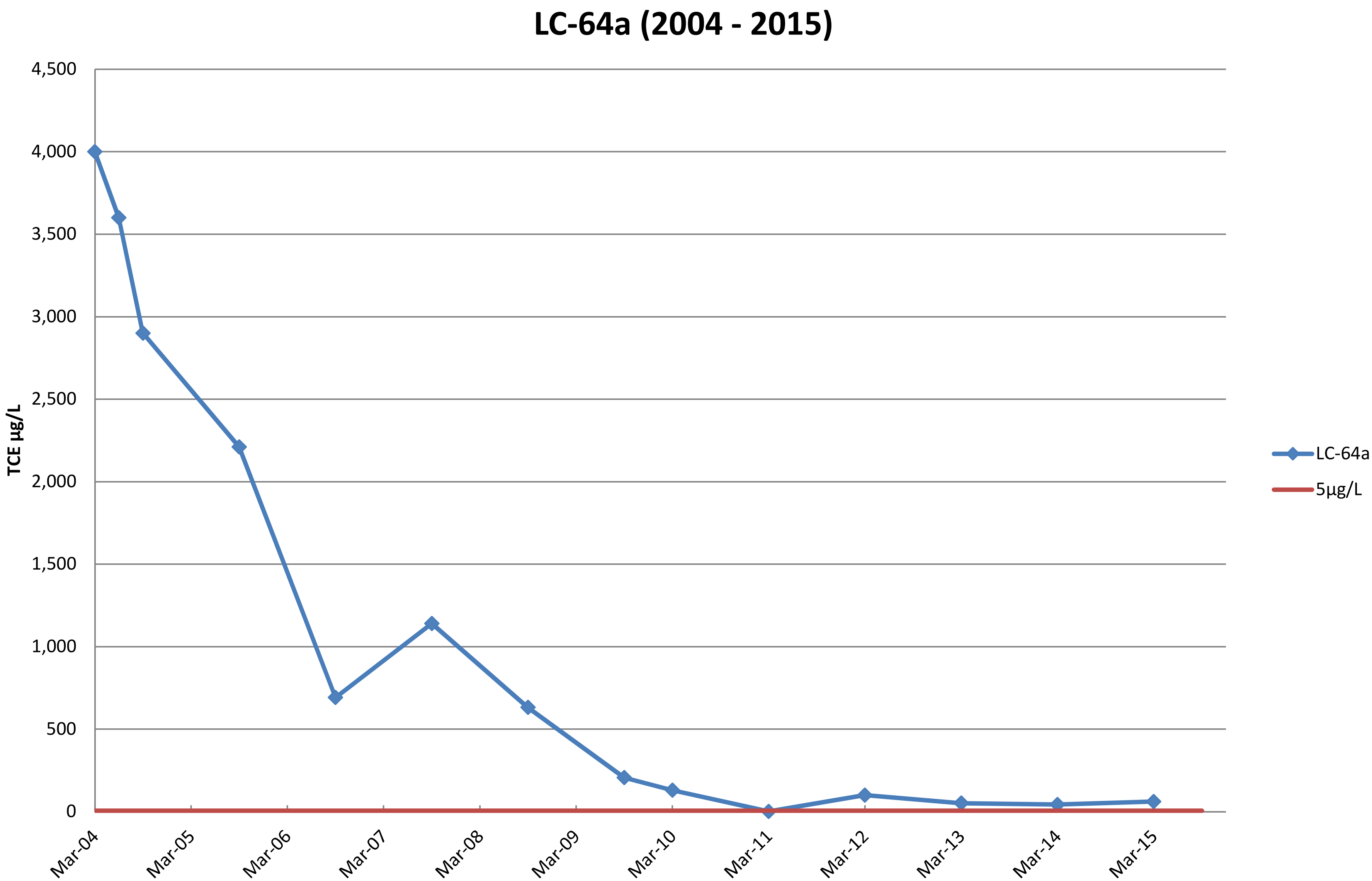

LC-49
350
300
250
200
150
100
50
0
TCE µg/L
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
LC-49
5µg/L

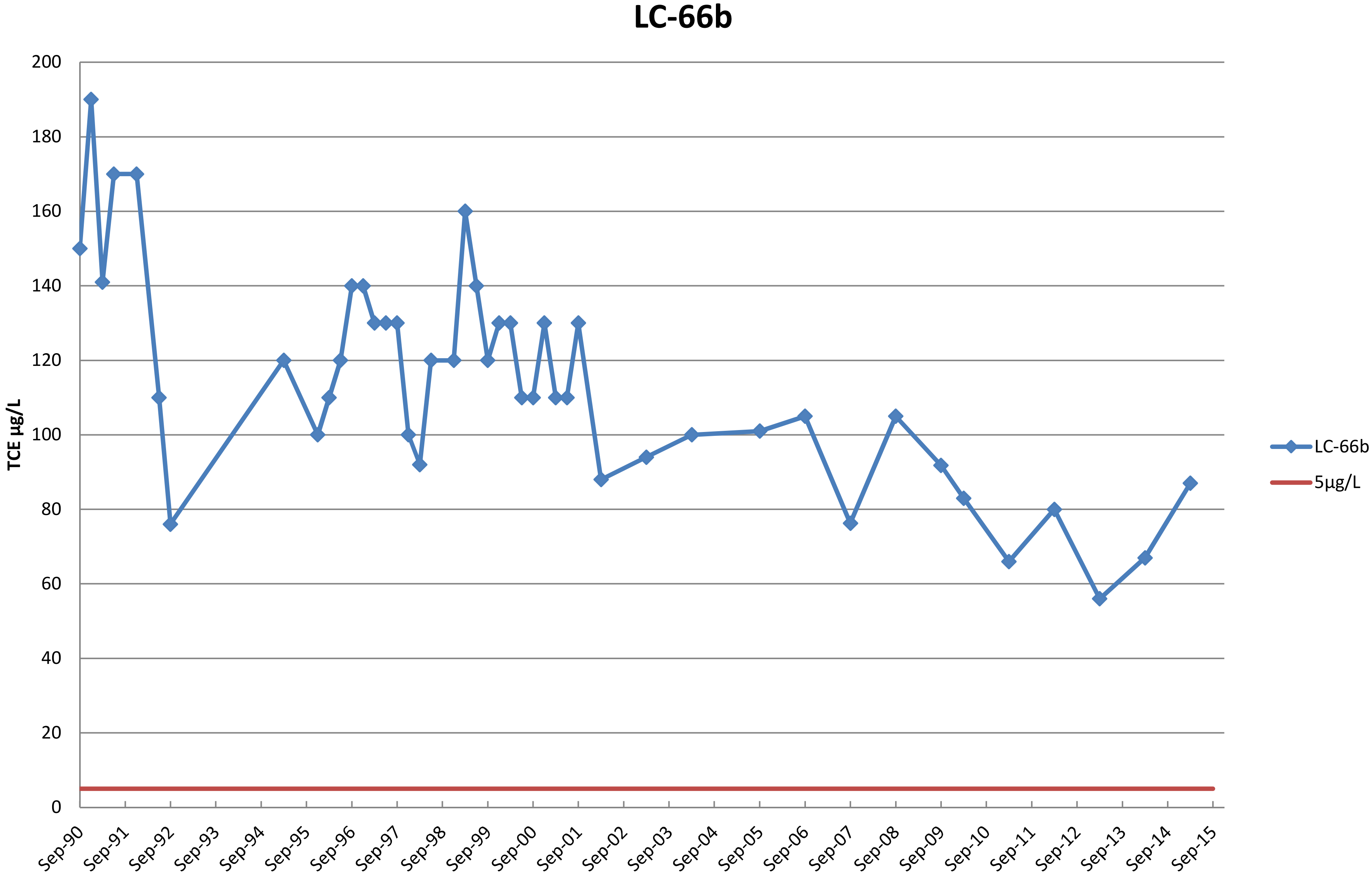

LC-53
TCE µg/L
300
250
200
150
100
50
0
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
LC-53
5µg/L

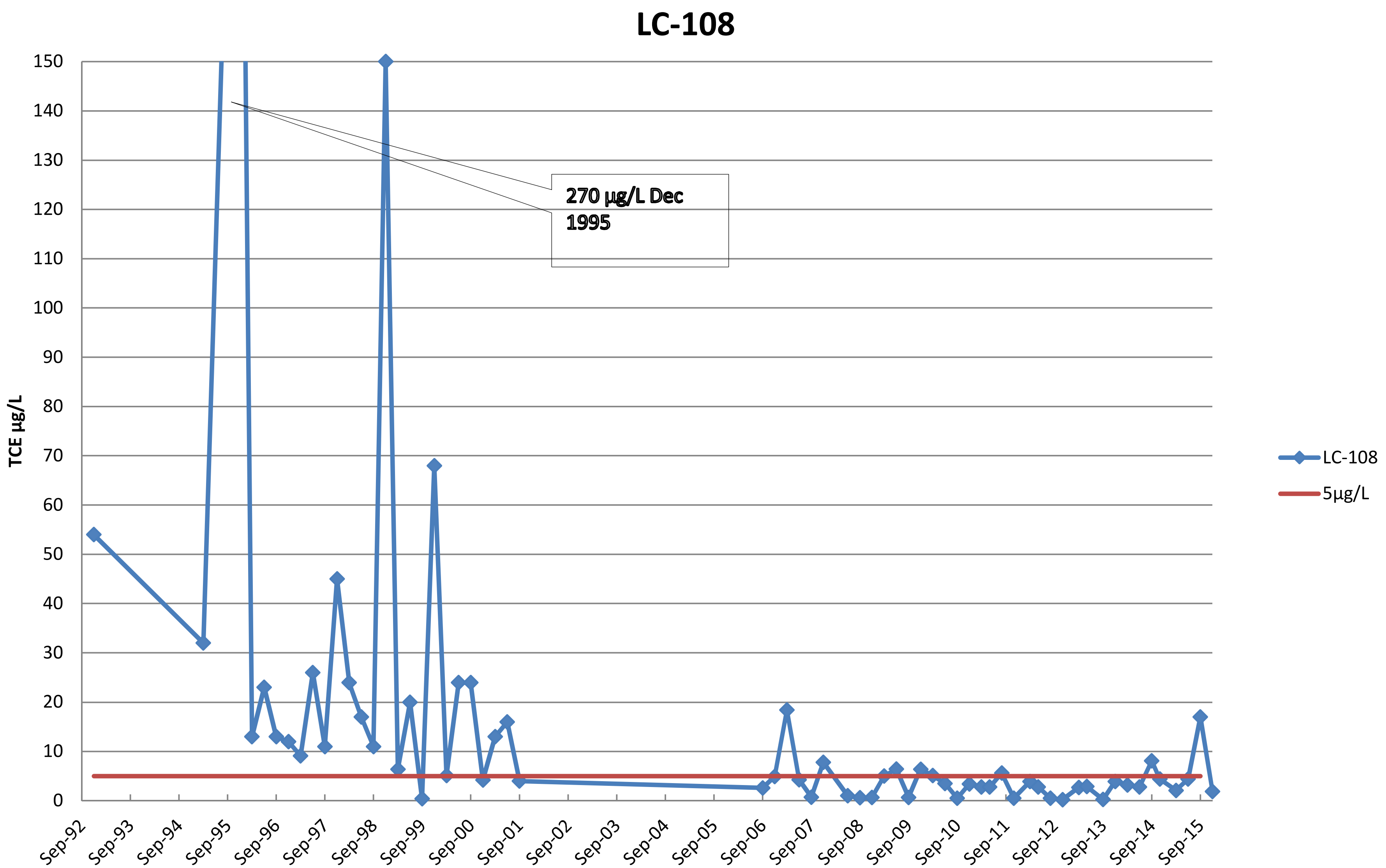

LC-57
TCE µg/L
0
1
2
3
4
5
6
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
LC-57
5µg/L

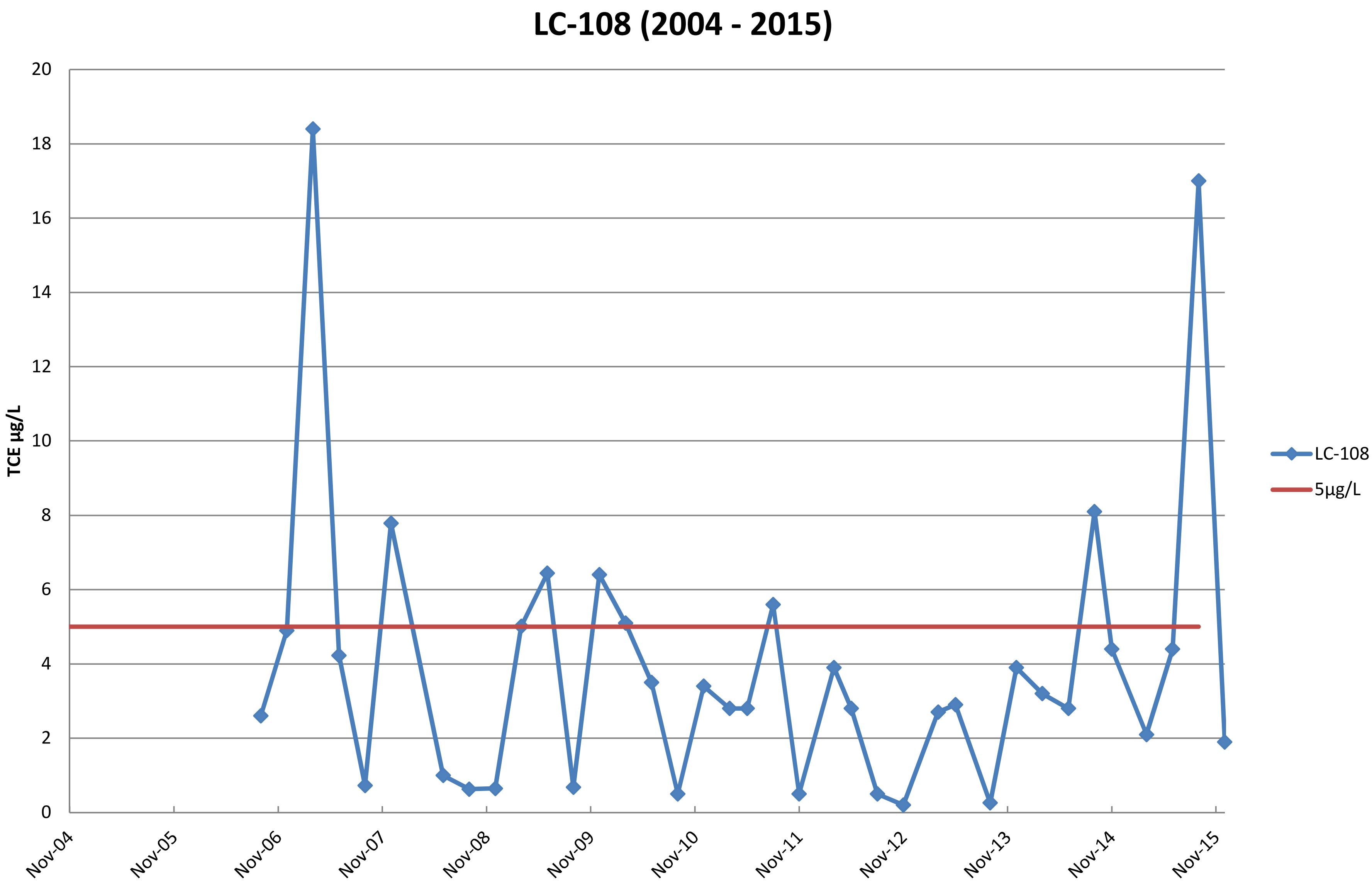

LC-61b
TCE µg/L
0
1
2
3
4
5
6
7
8
9
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-61b
5µg/L

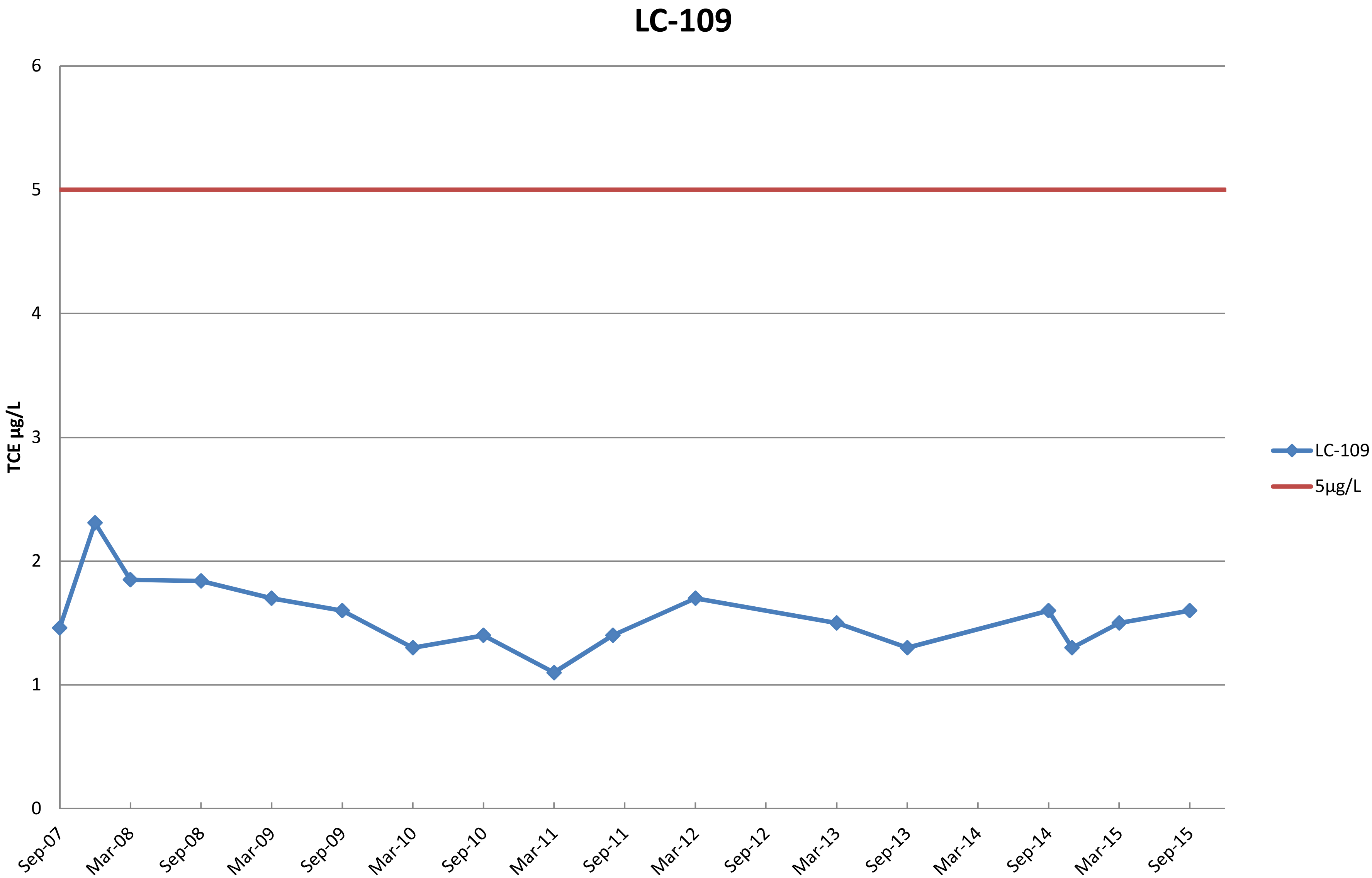

LC-64a
TCE µg/L
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Sep-90
Sep-91
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-64a
5µg/L

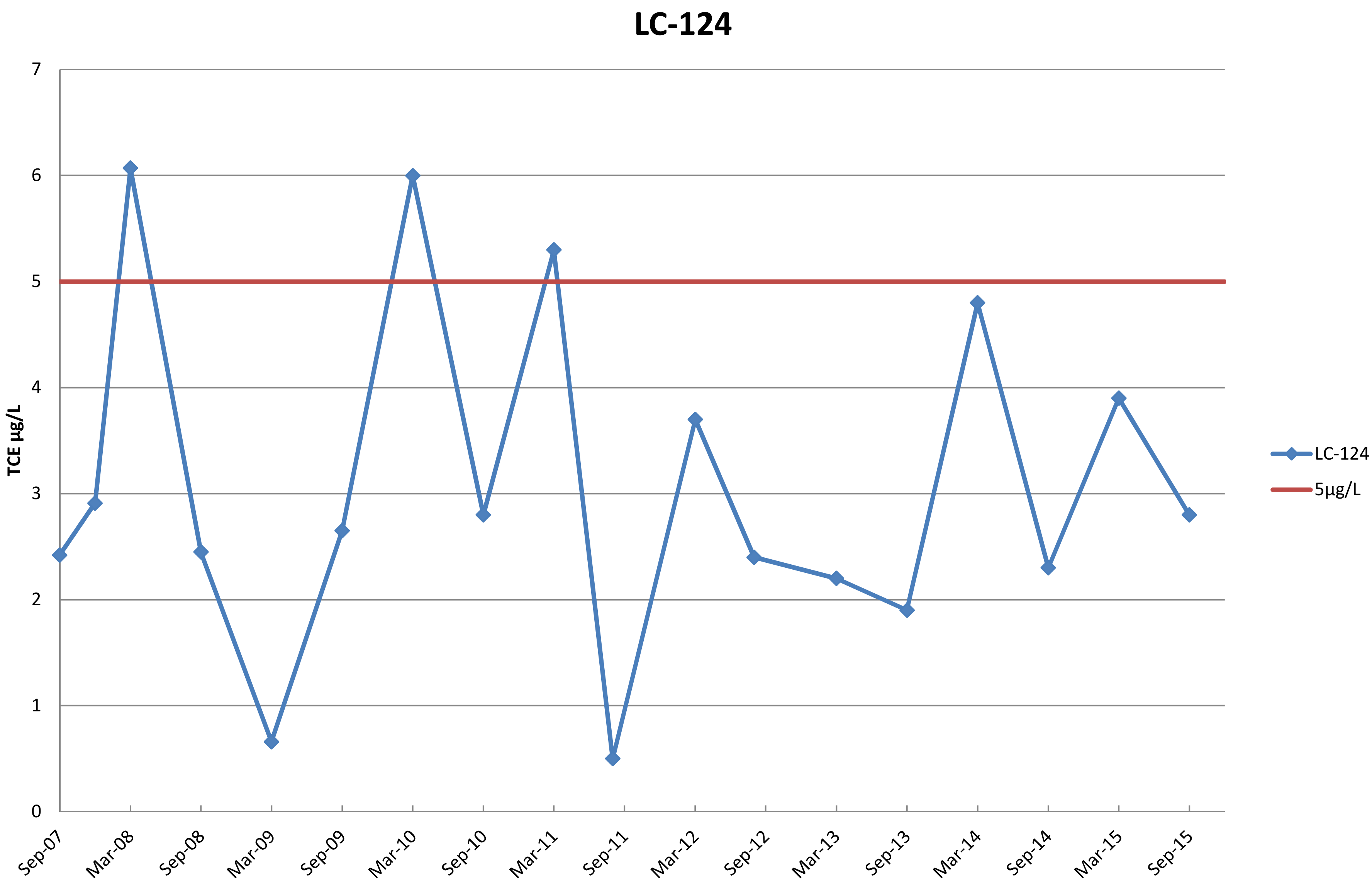

LC-64a (2004 - 2015)
TCE µg/L
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
LC-64a
5µg/L

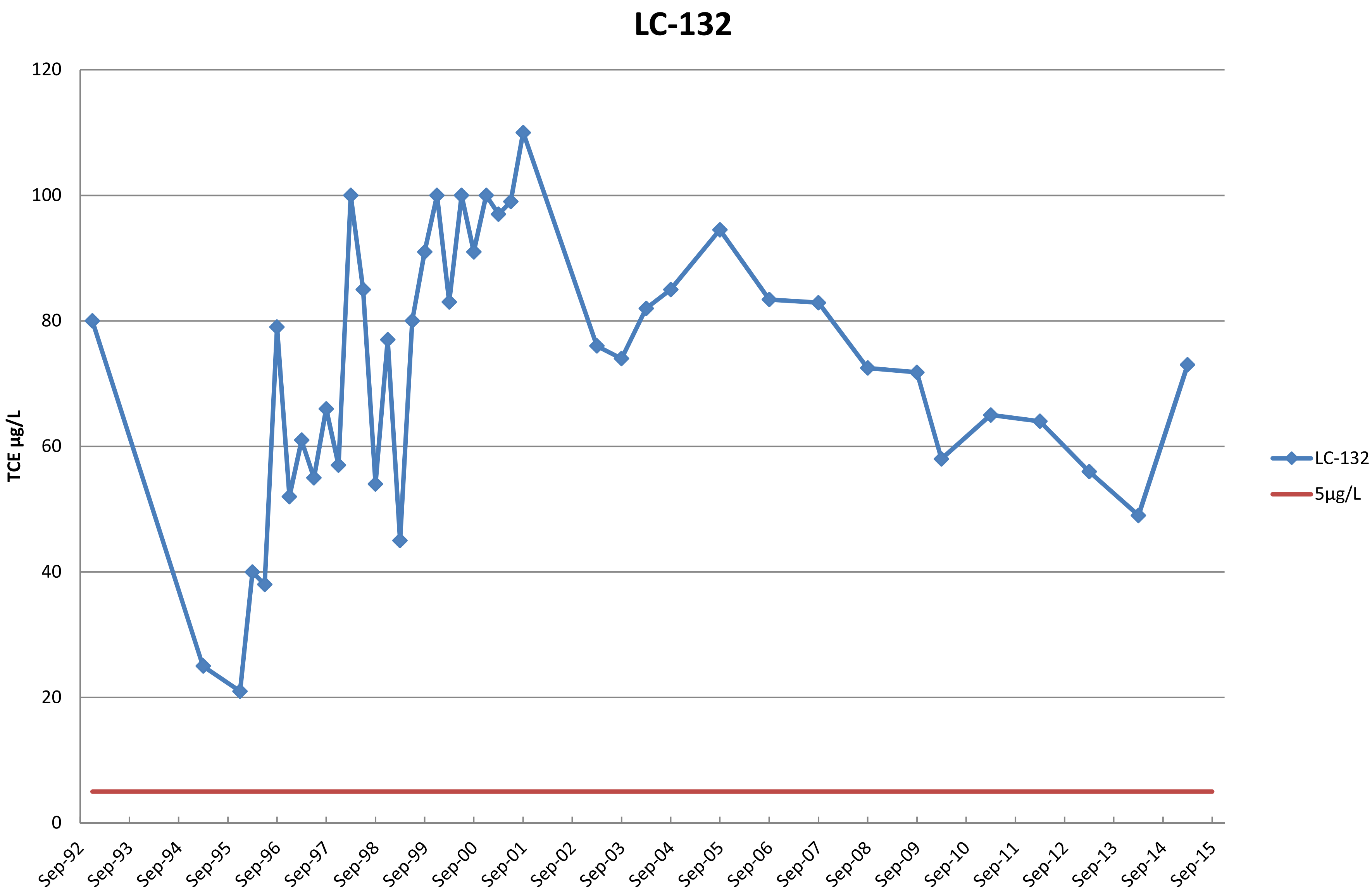

LC-66b
TCE µg/L
200
180
160
140
120
100
80
60
40
20
0
Sep-90
Sep-91
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-66b
5µg/L

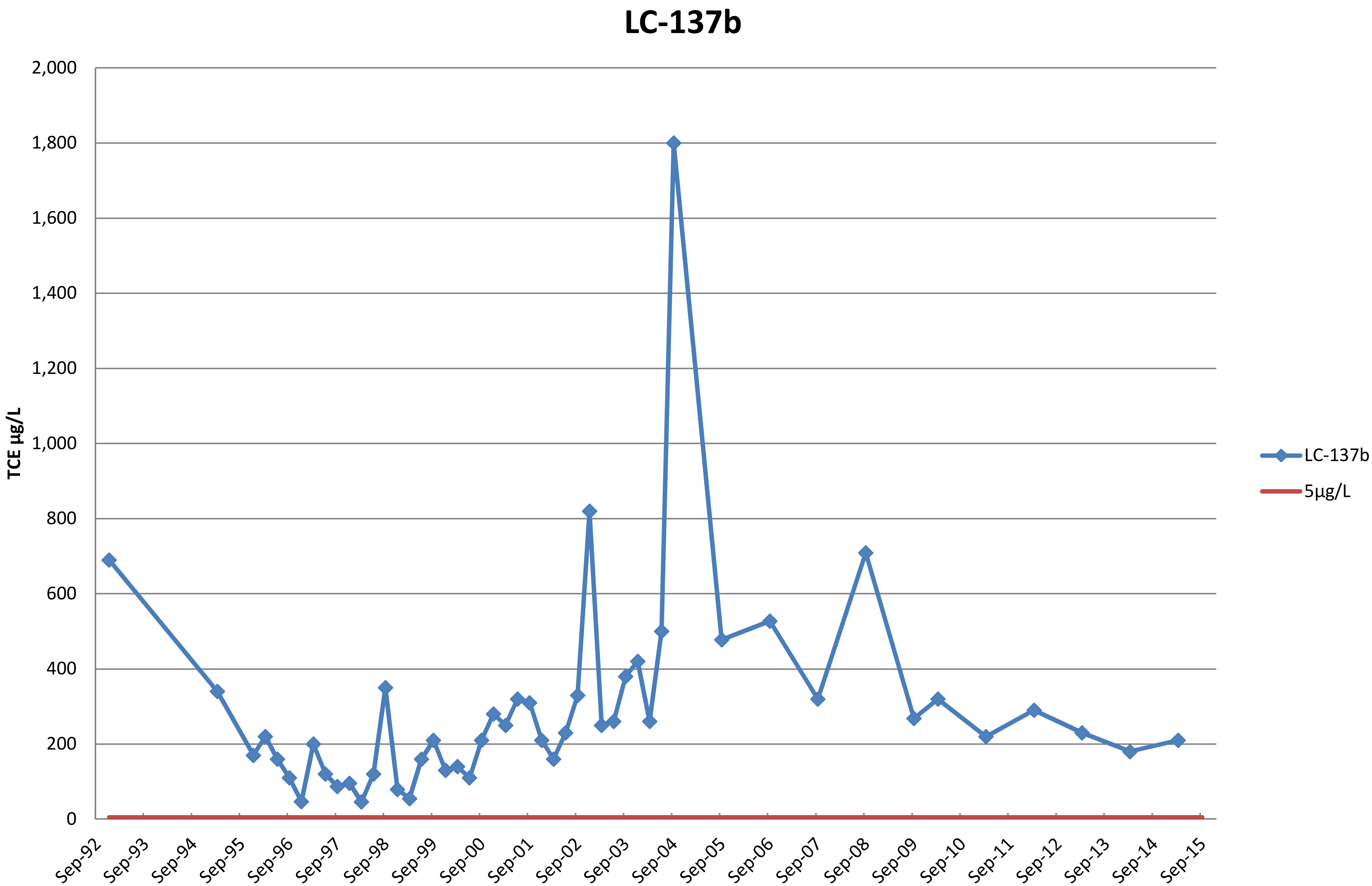

LC-108
TCE µg/L
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
270 µg/L Dec 1995
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-108
5µg/L

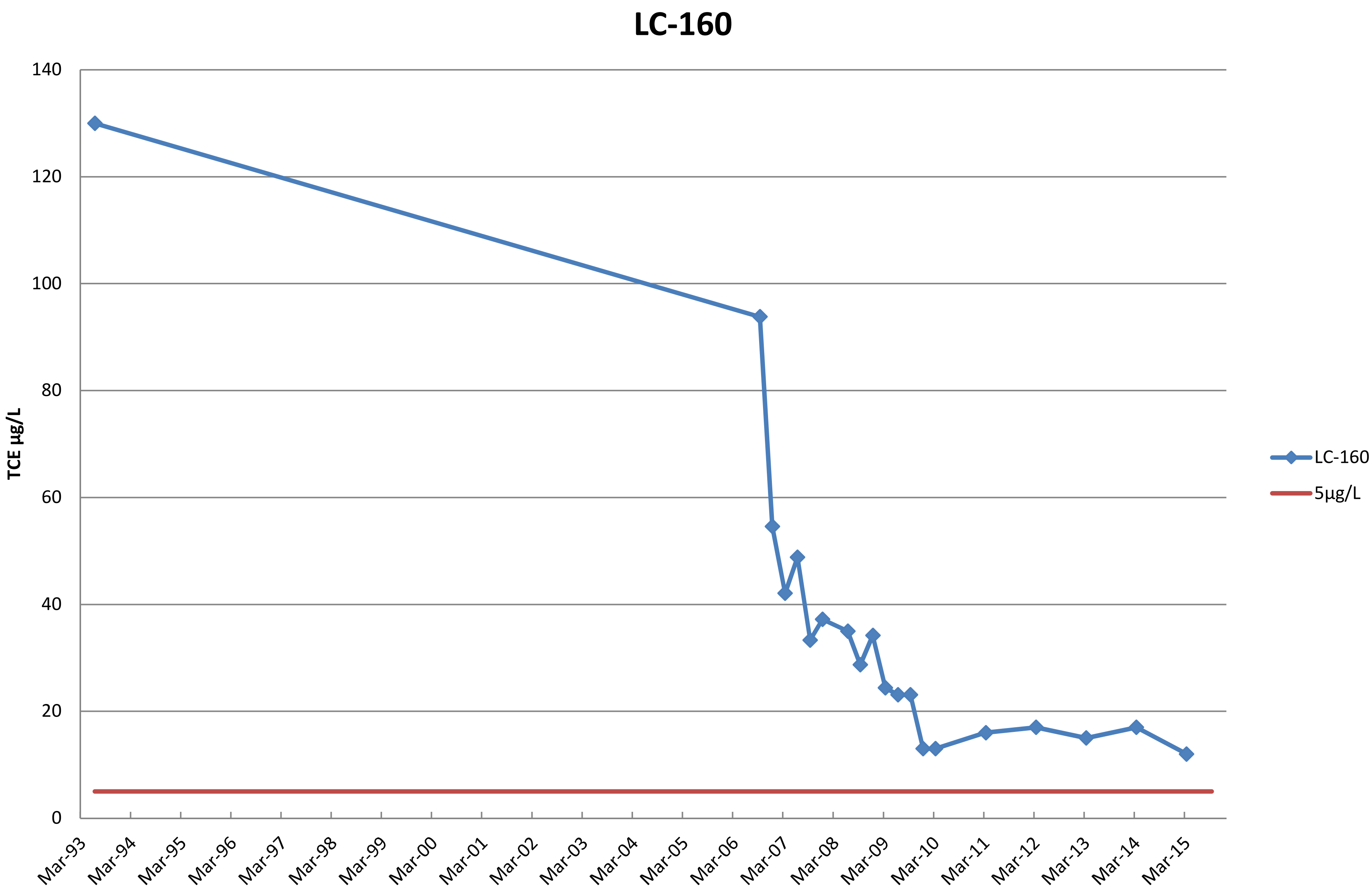

LC-108 (2004 - 2015)
TCE µg/L
0
2
4
6
8
10
12
14
16
18
20
Nov-04
Nov-05
Nov-06
Nov-07
Nov-08
Nov-09
Nov-10
Nov-11
Nov-12
Nov-13
Nov-14
Nov-15
LC-108
5µg/L

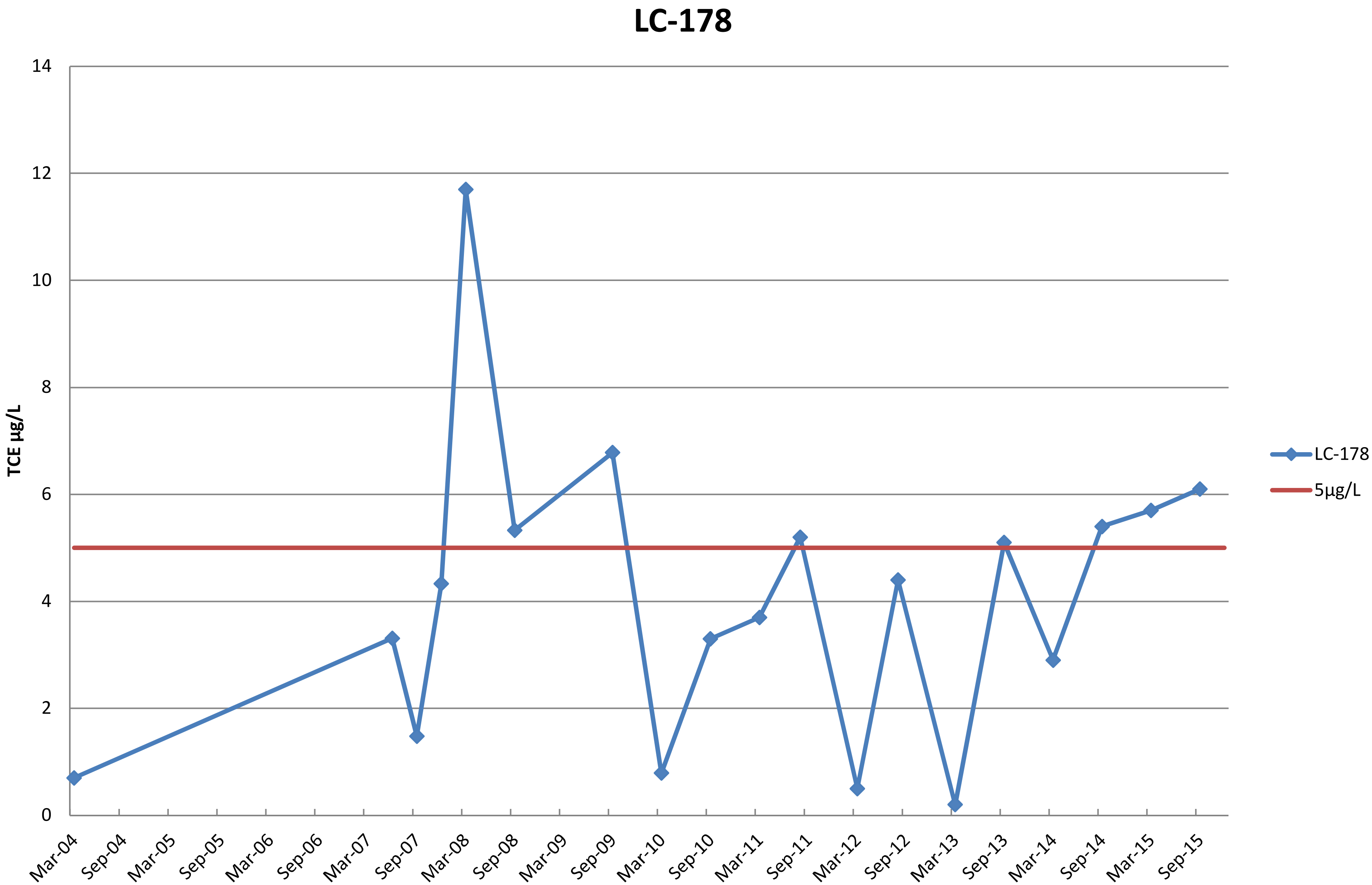

LC-109
TCE µg/L
0
1
2
3
4
5
6
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-109
5µg/L

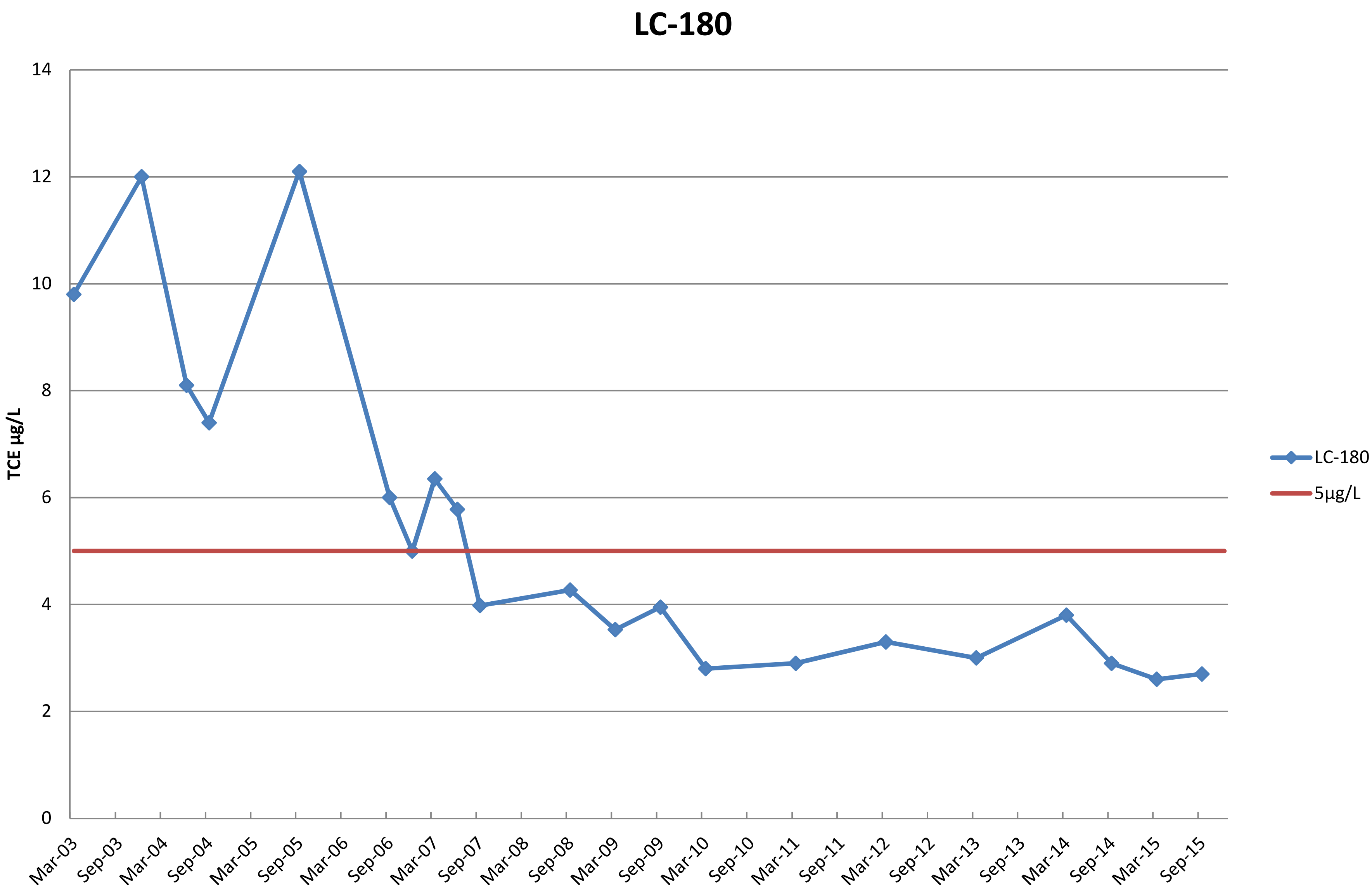

LC-124
7
6
5
4
3
2
1
0
TCE µg/L
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-124
5µg/L

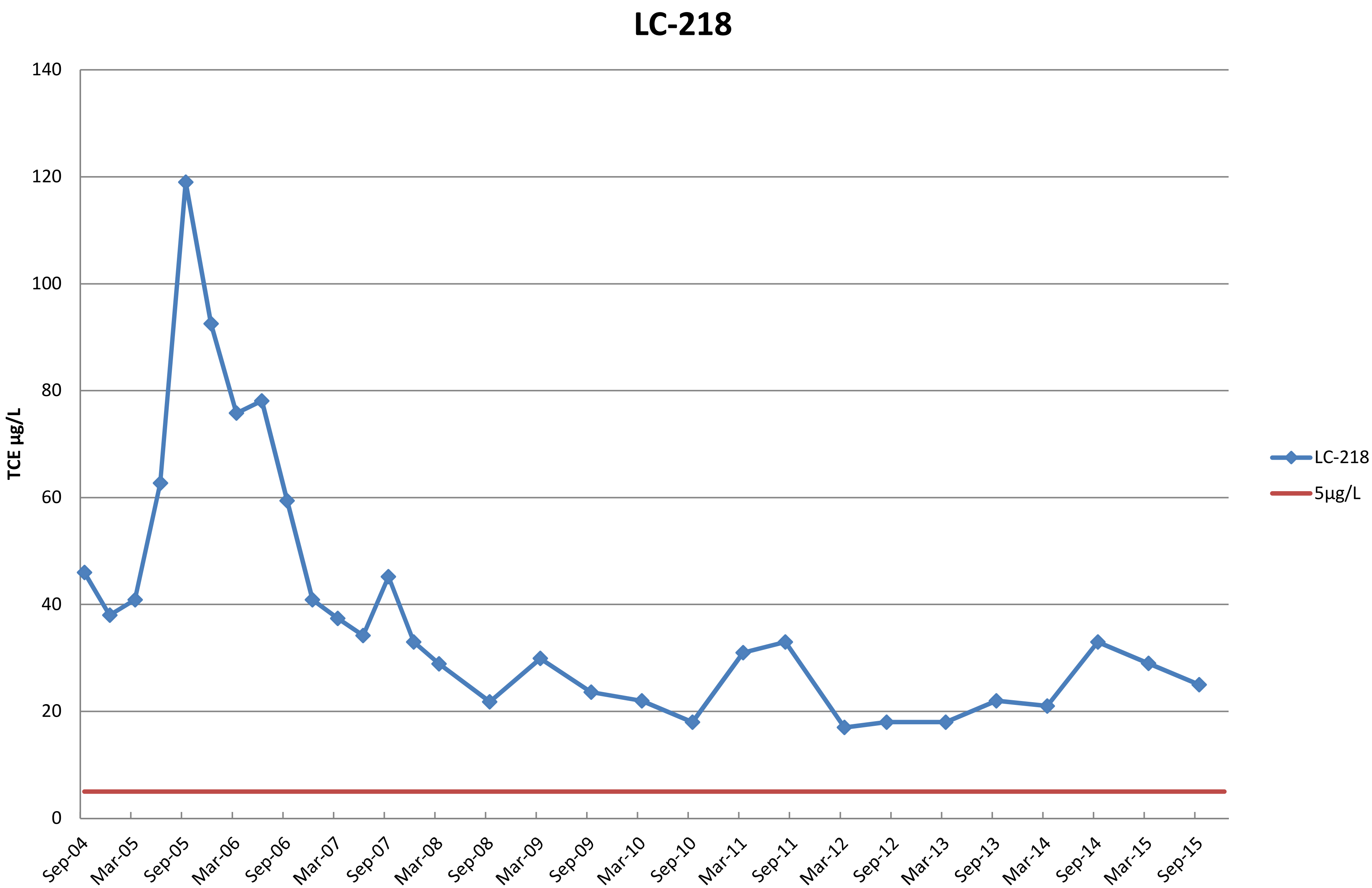

LC-132
TCE µg/L
120
100
80
60
40
20
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-132
5µg/L

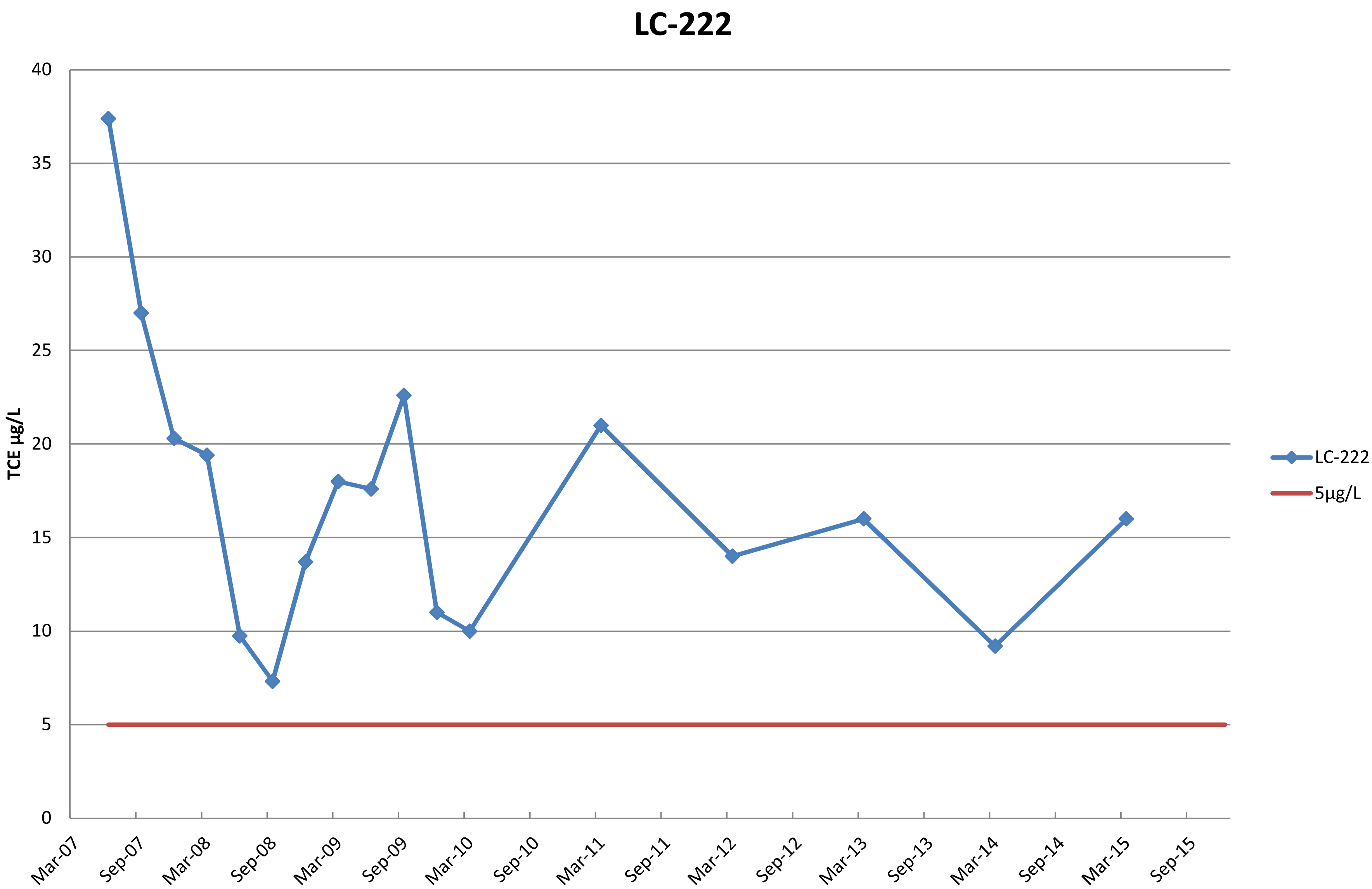

LC-137b
TCE µg/L
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-137b
5µg/L

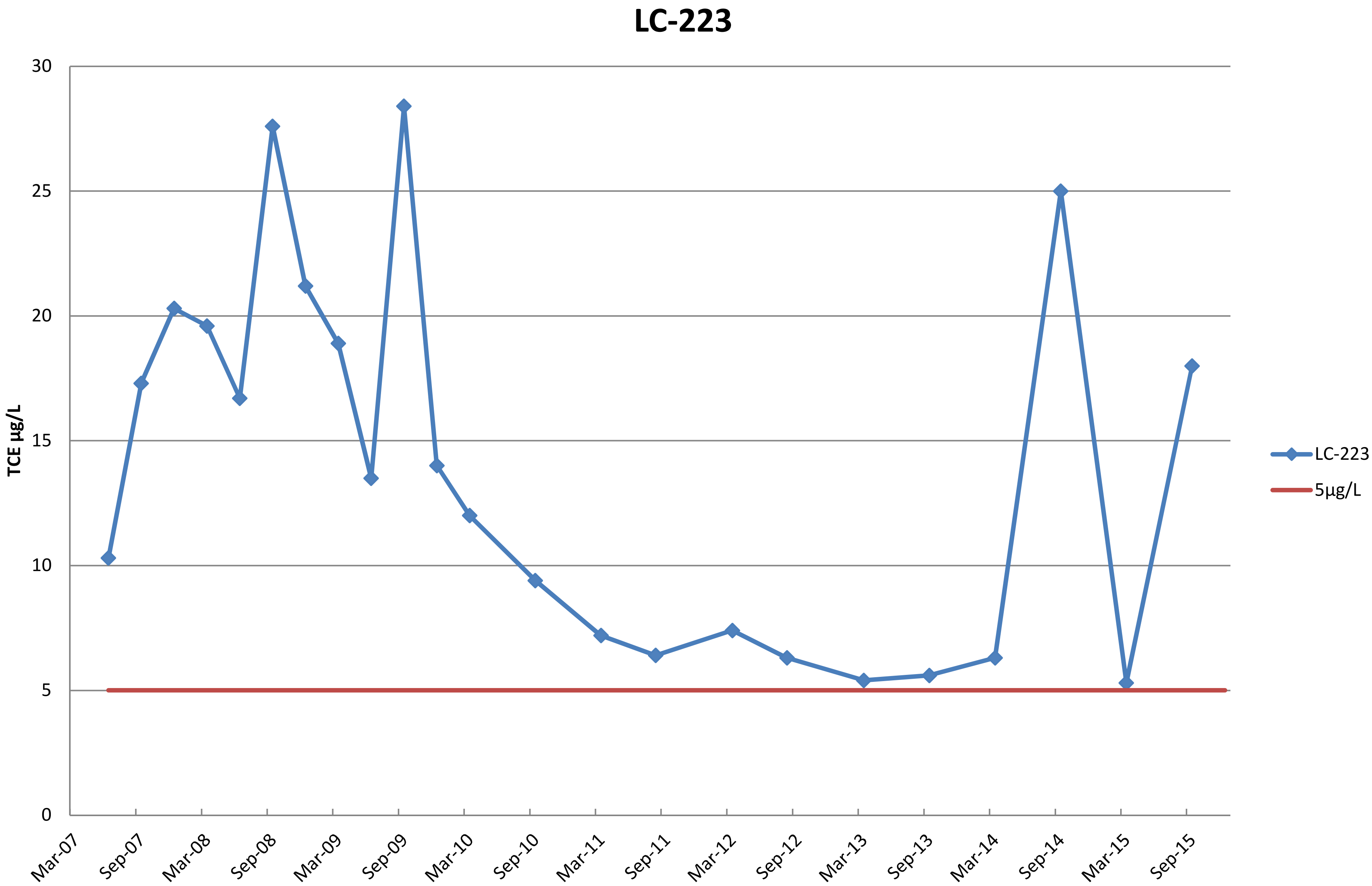

LC-160
140
120
100
80
60
40
20
0
TCE µg/L
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
LC-160
5µg/L

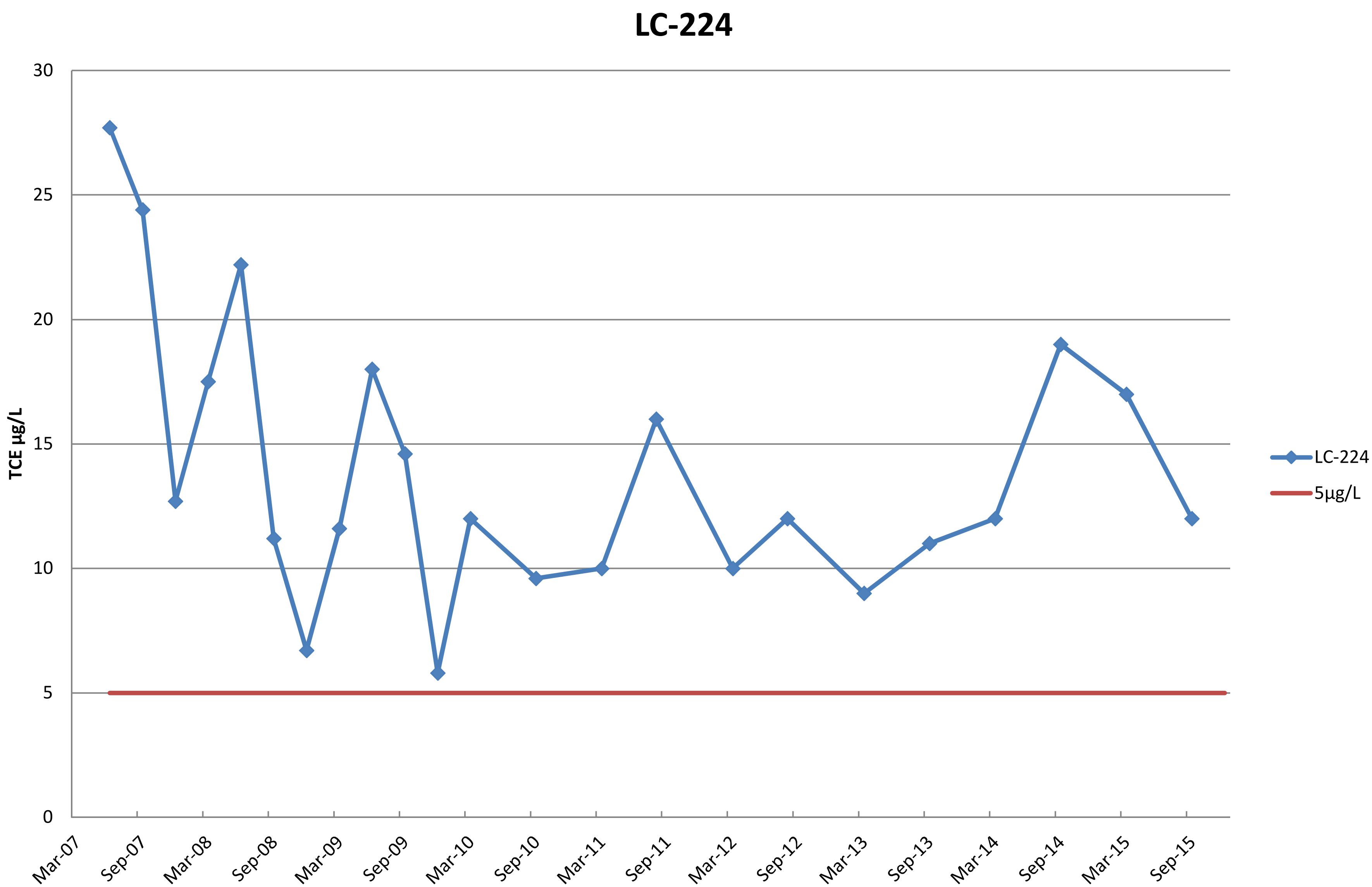

LC-178
TCE µg/L
14
12
10
8
6
4
2
0
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-178
5µg/L


LC-180
TCE µg/L
14
12
10
8
6
4
2
0
Mar-03
Sep-03
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-180
5µg/L


LC-218
TCE µg/L
140
120
100
80
60
40
20
0
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-218
5µg/L


LC-222
TCE µg/L
40
35
30
25
20
15
10
5
0
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-222
5µg/L

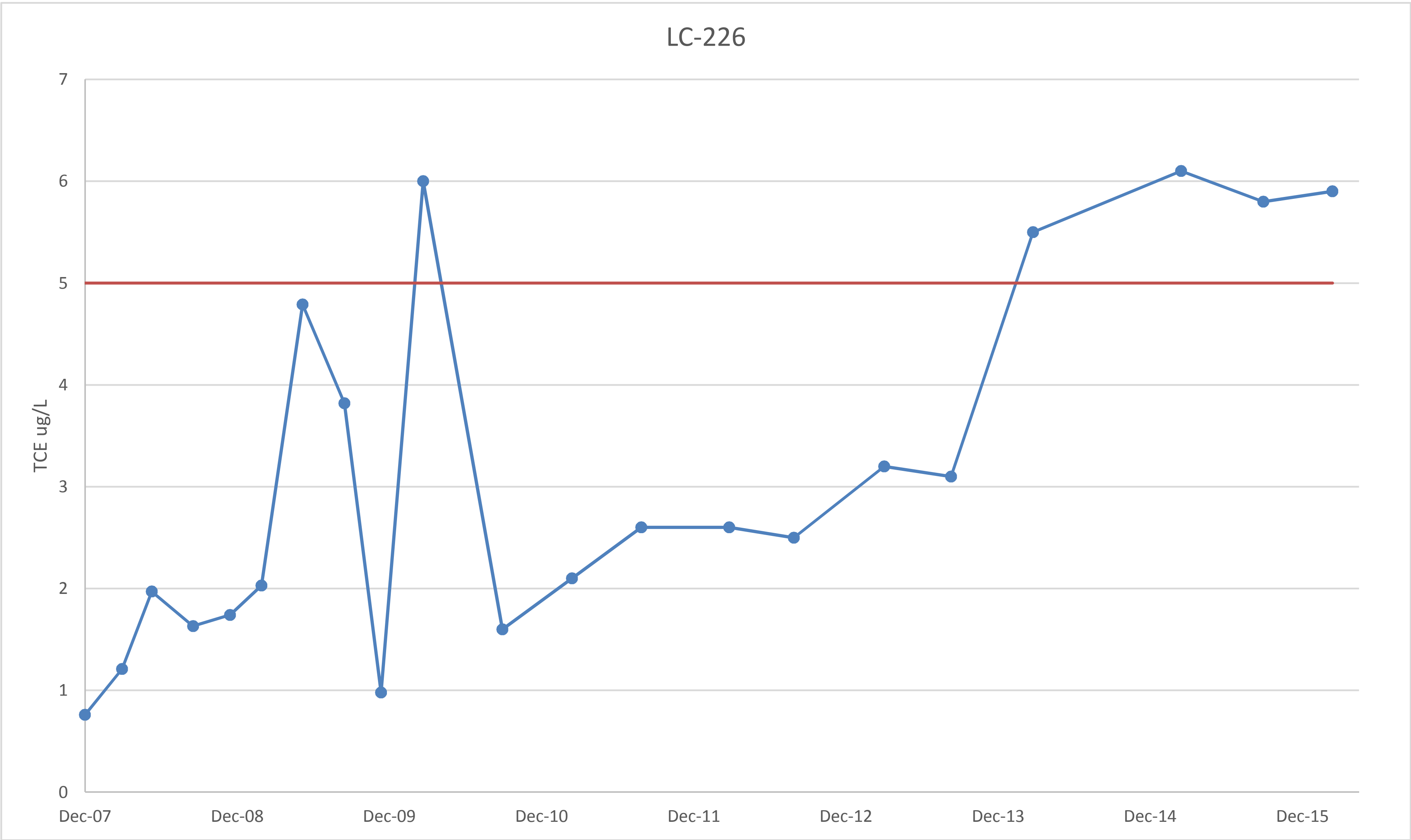

LC-223
30
25
20
15
10
5
0
TCE µg/L
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-223
5µg/L

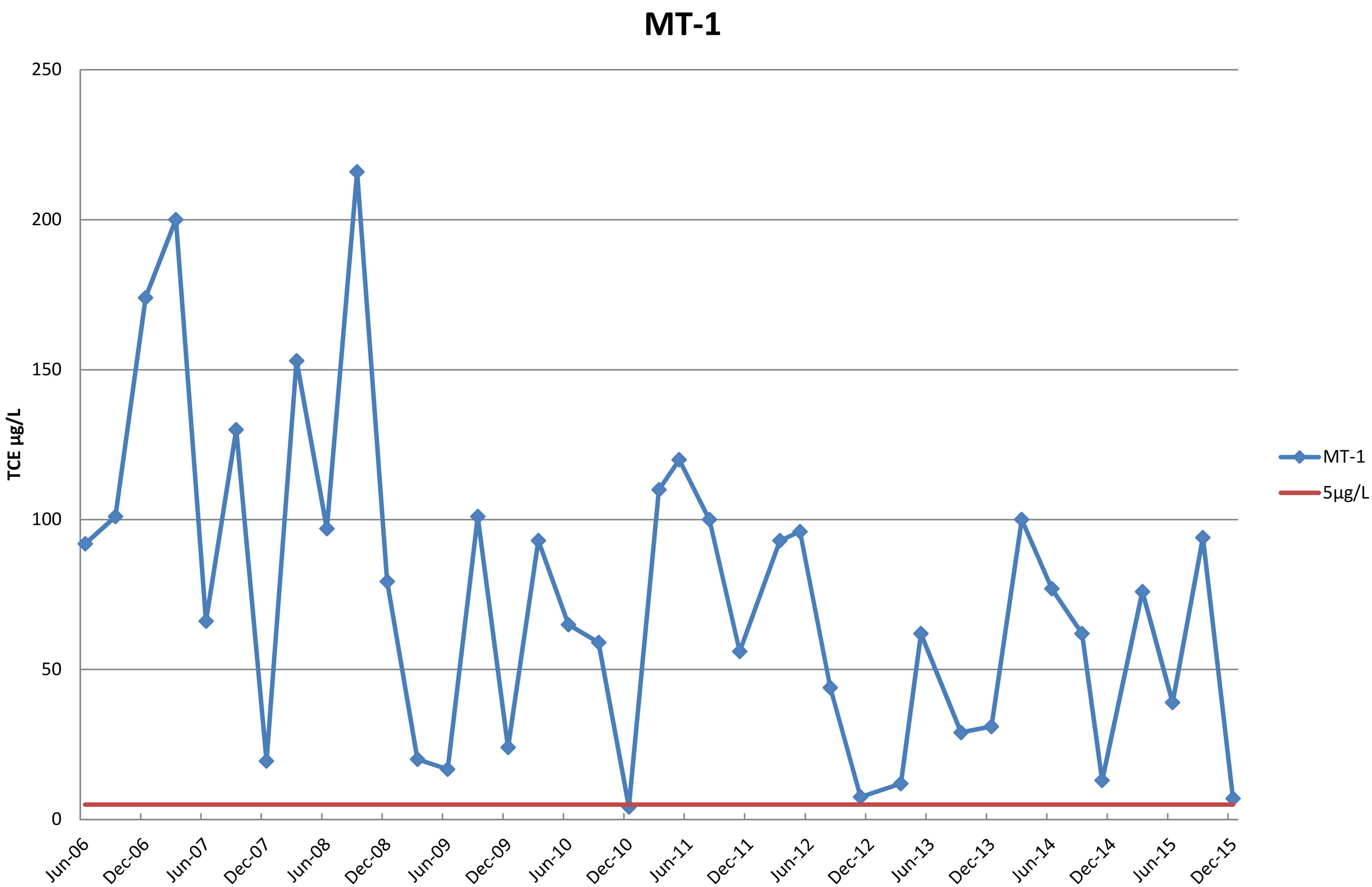

LC-224
30
25
20
15
10
5
0
TCE µg/L
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-224
5µg/L

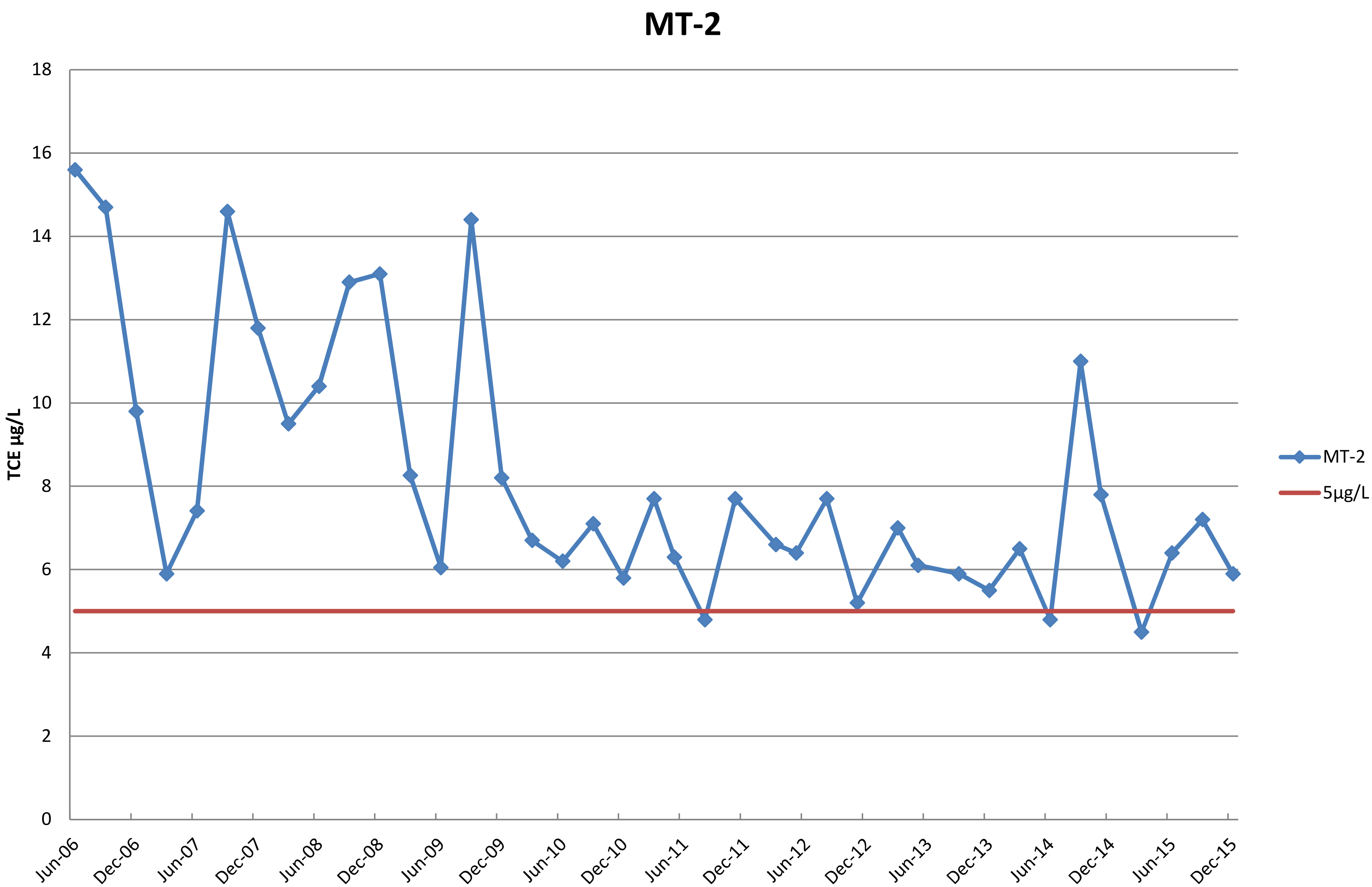
Appendix E - Historical Analytical Results and TCE Linear Graphs

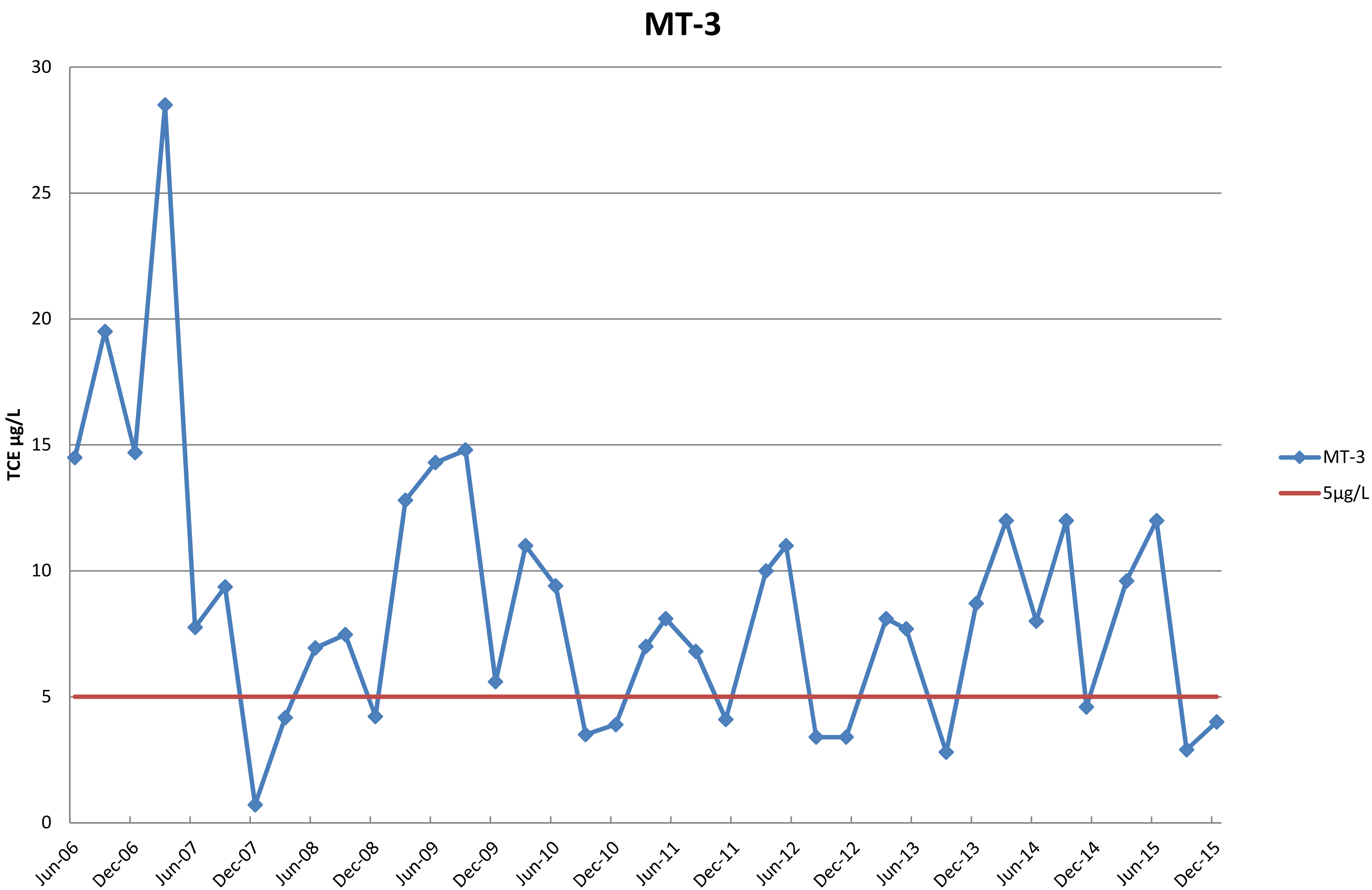
Lower Vashon Aquifer TCE Linear Graphs

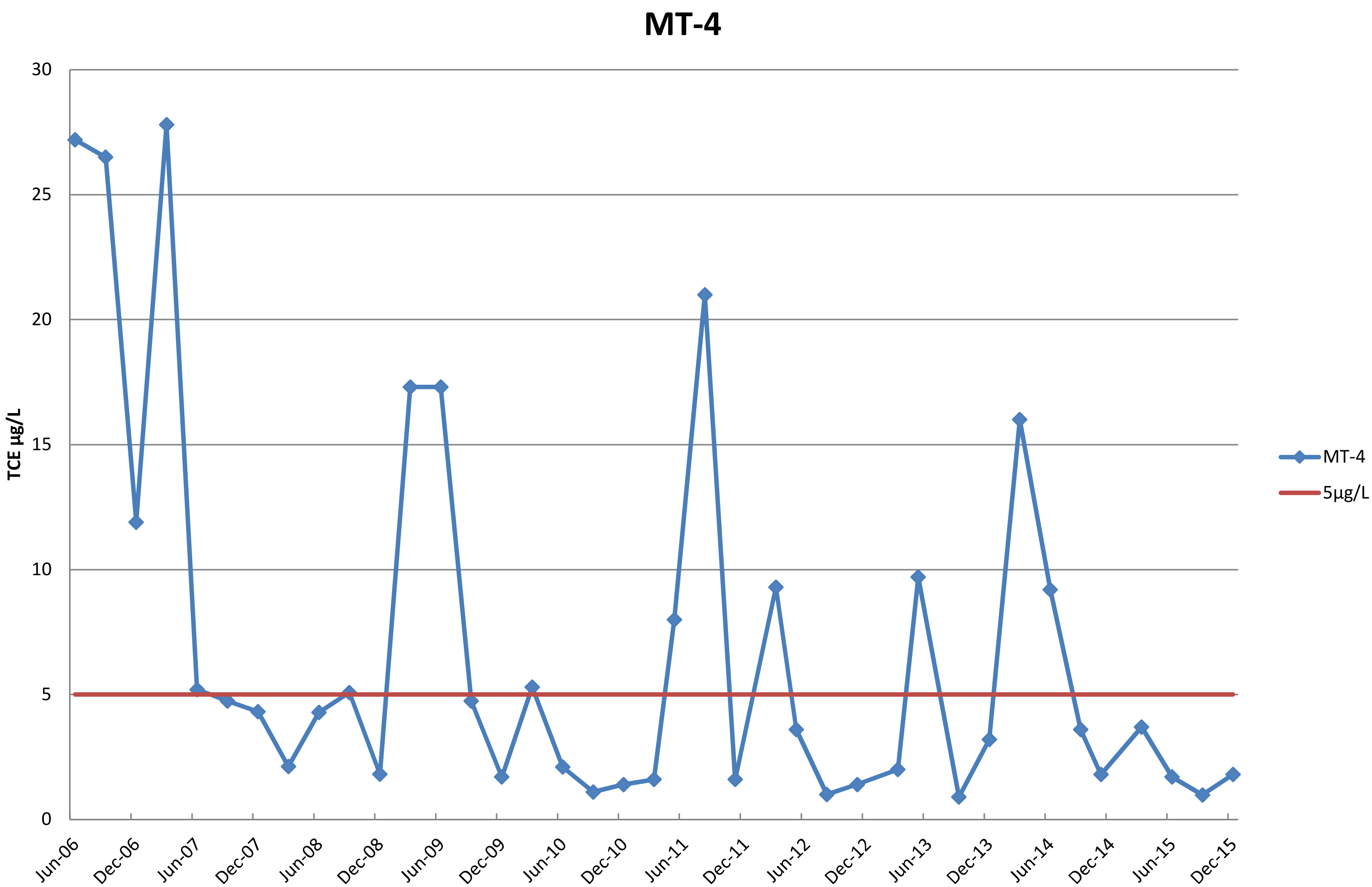
Log RAM - Joint Base Lewis McChord, Washington 98433

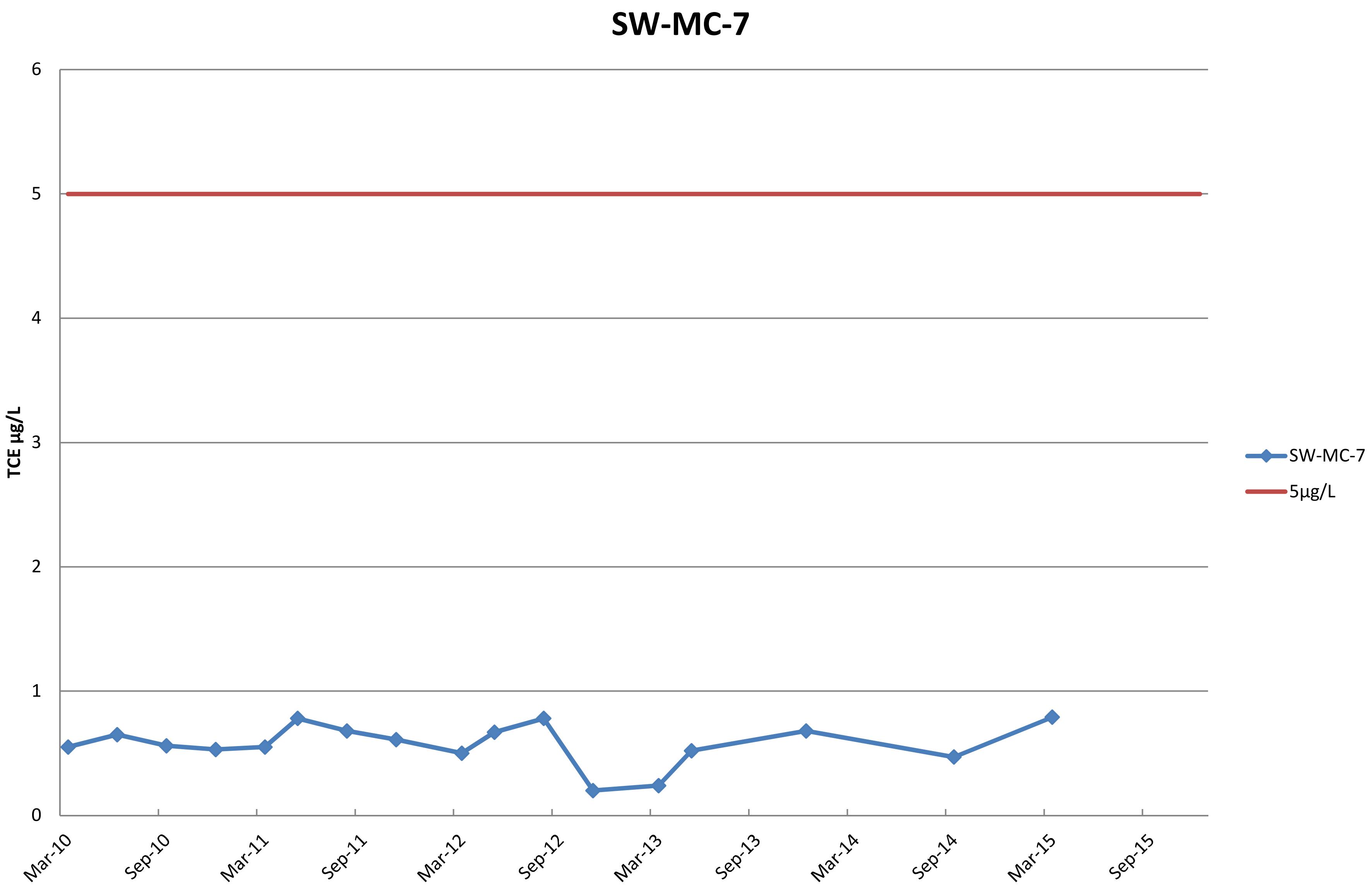


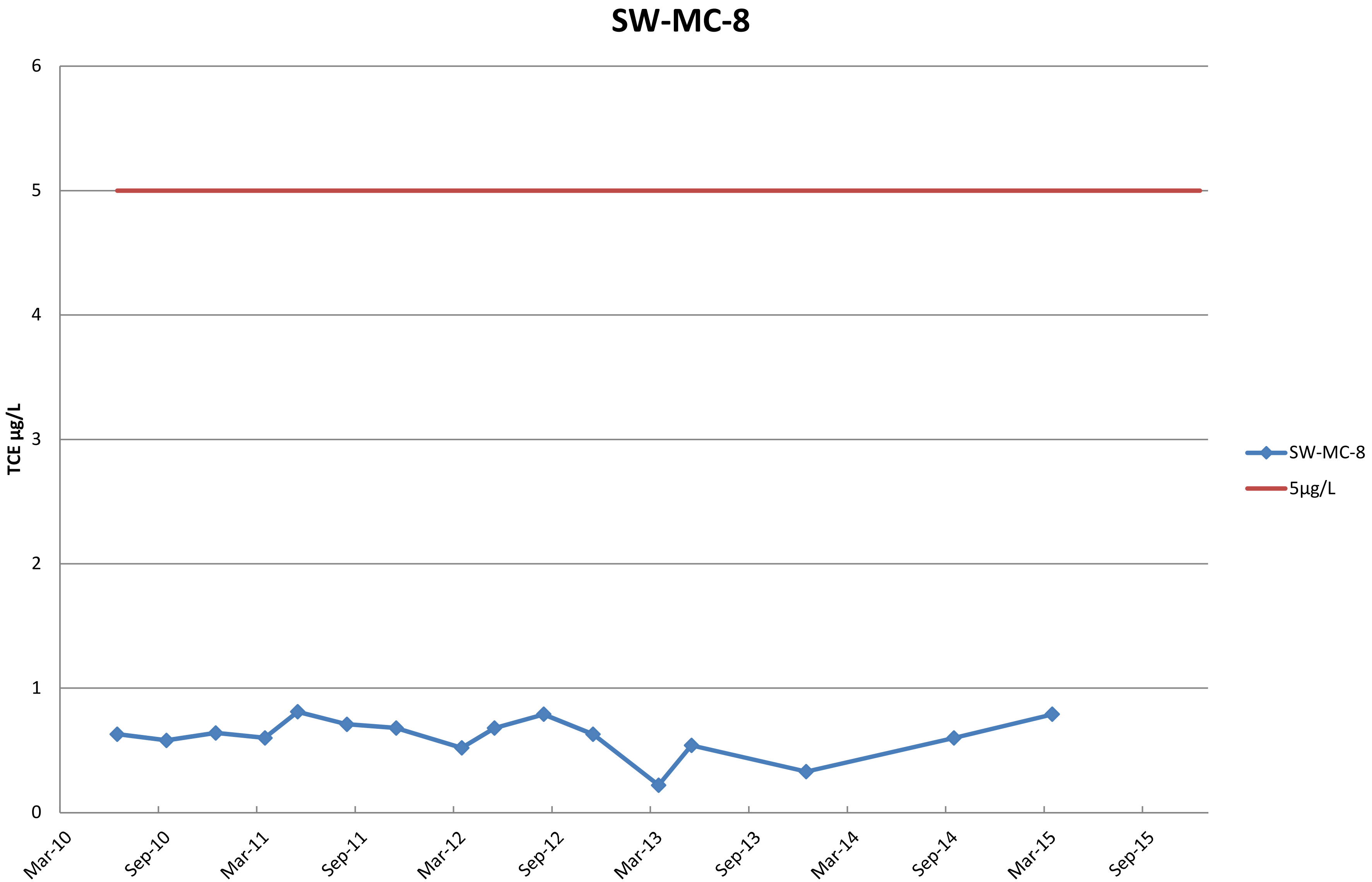

MT-1
TCE µg/L
250
200
150
100
50
0
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
MT-1
5µg/L

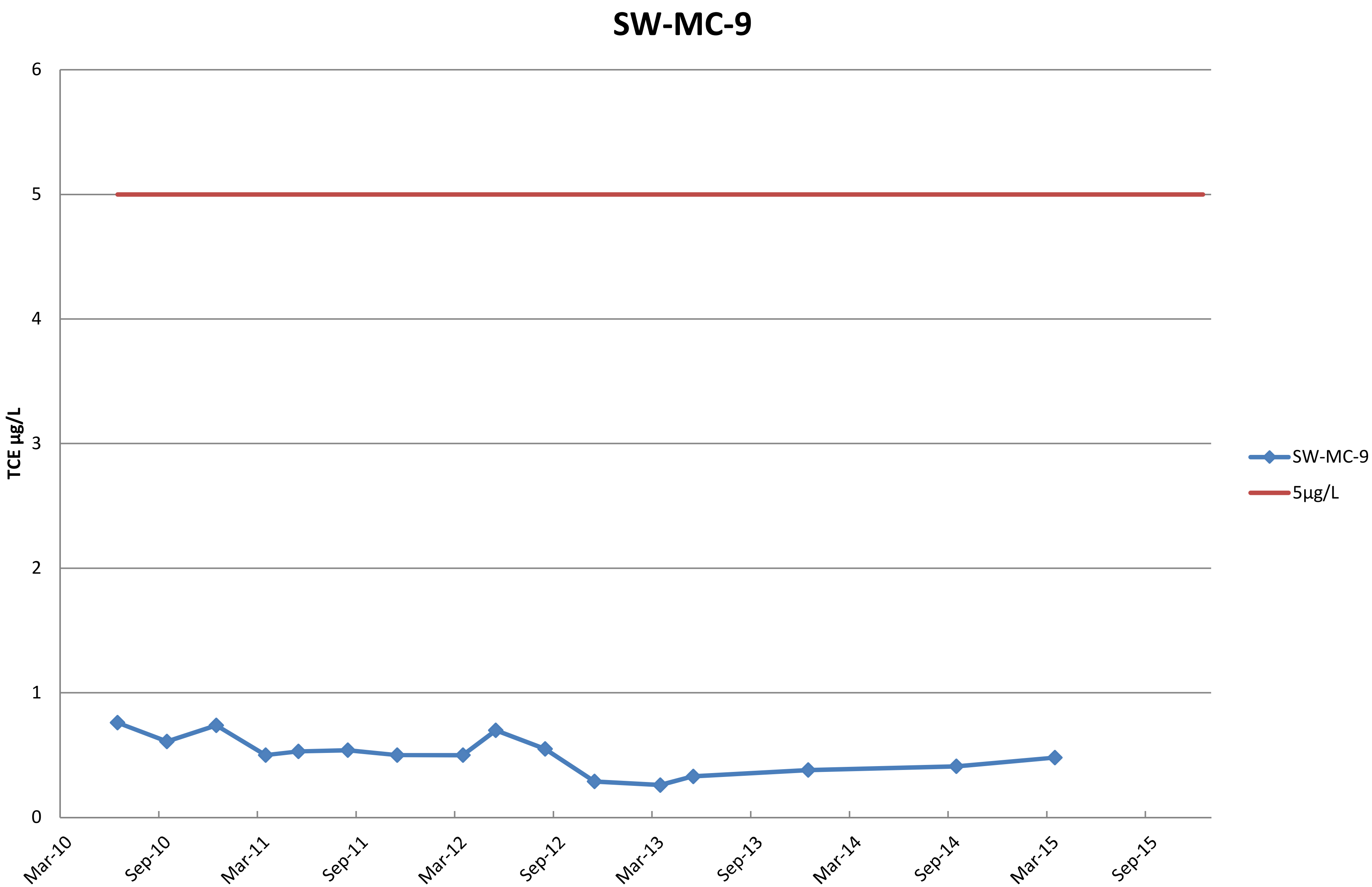

MT-2
TCE µg/L
0
2
4
6
8
10
12
14
16
18
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
MT-2
5µg/L

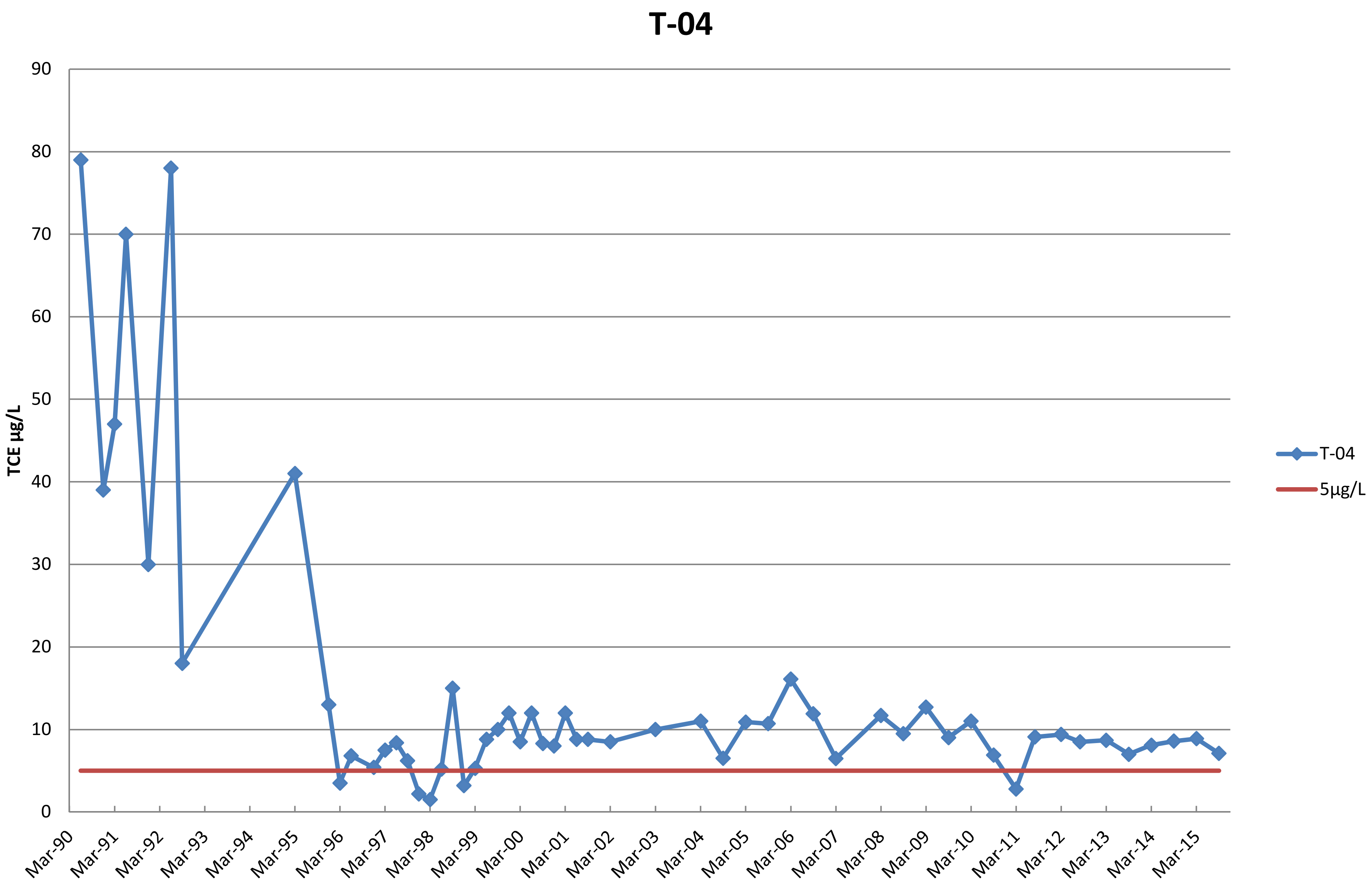

MT-3
TCE µg/L
30
25
20
15
10
5
0
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
MT-3
5µg/L


MT-4
TCE µg/L
30
25
20
15
10
5
0
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
MT-4
5µg/L

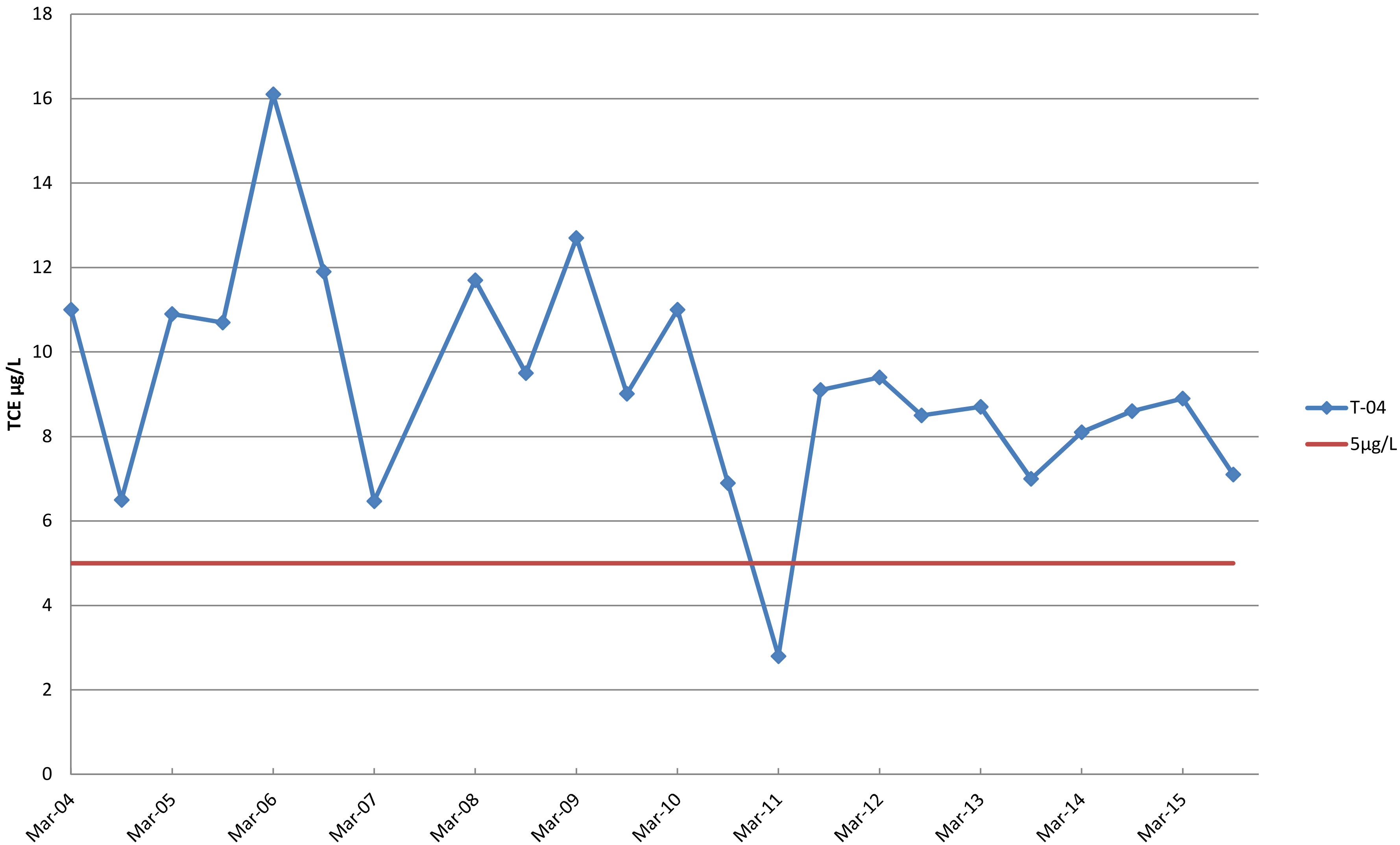

SW-MC-7
TCE µg/L
0
1
2
3
4
5
6
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
SW-MC-7
5µg/L

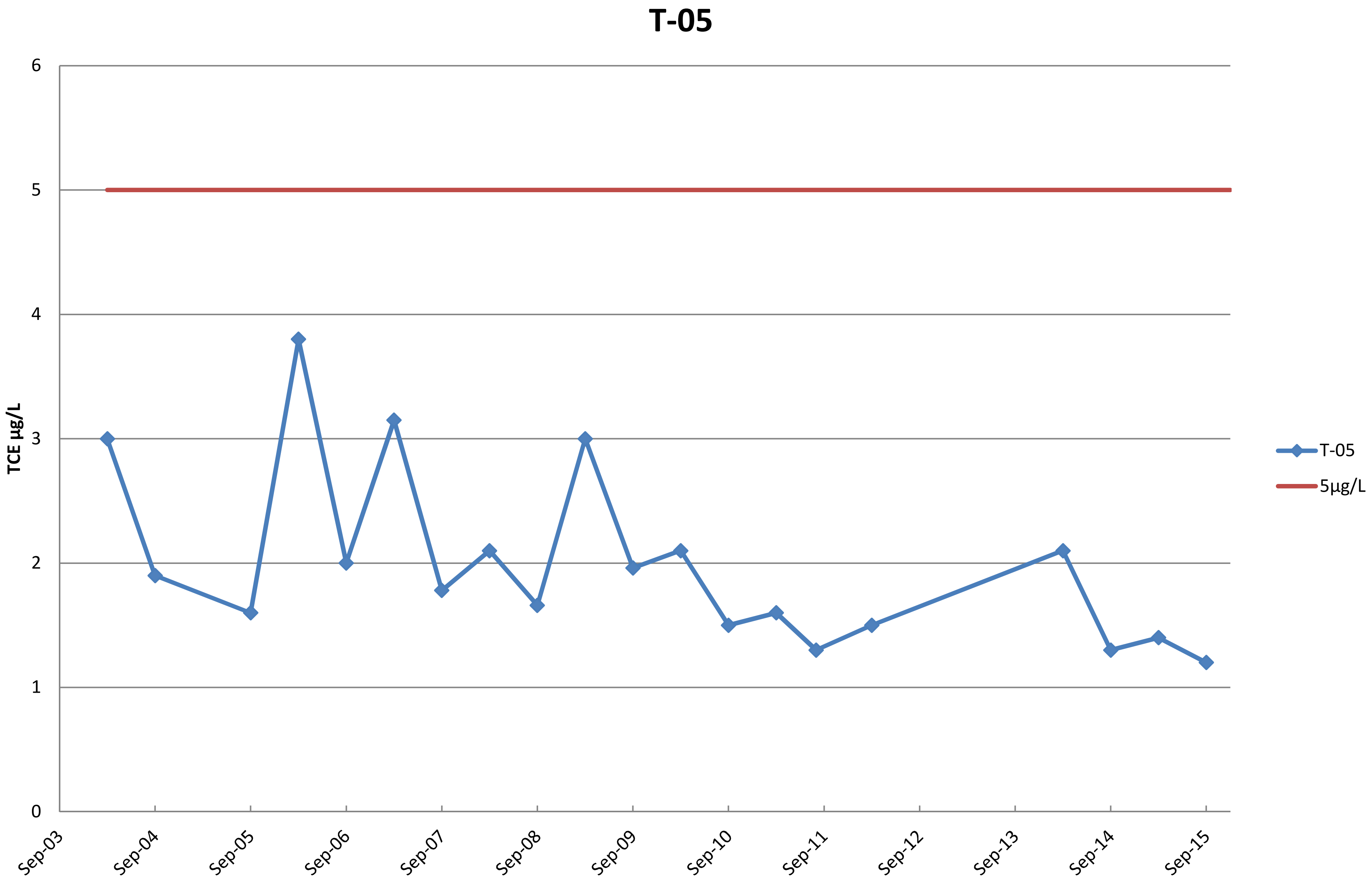

SW-MC-8
TCE µg/L
0
1
2
3
4
5
6
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
SW-MC-8
5µg/L

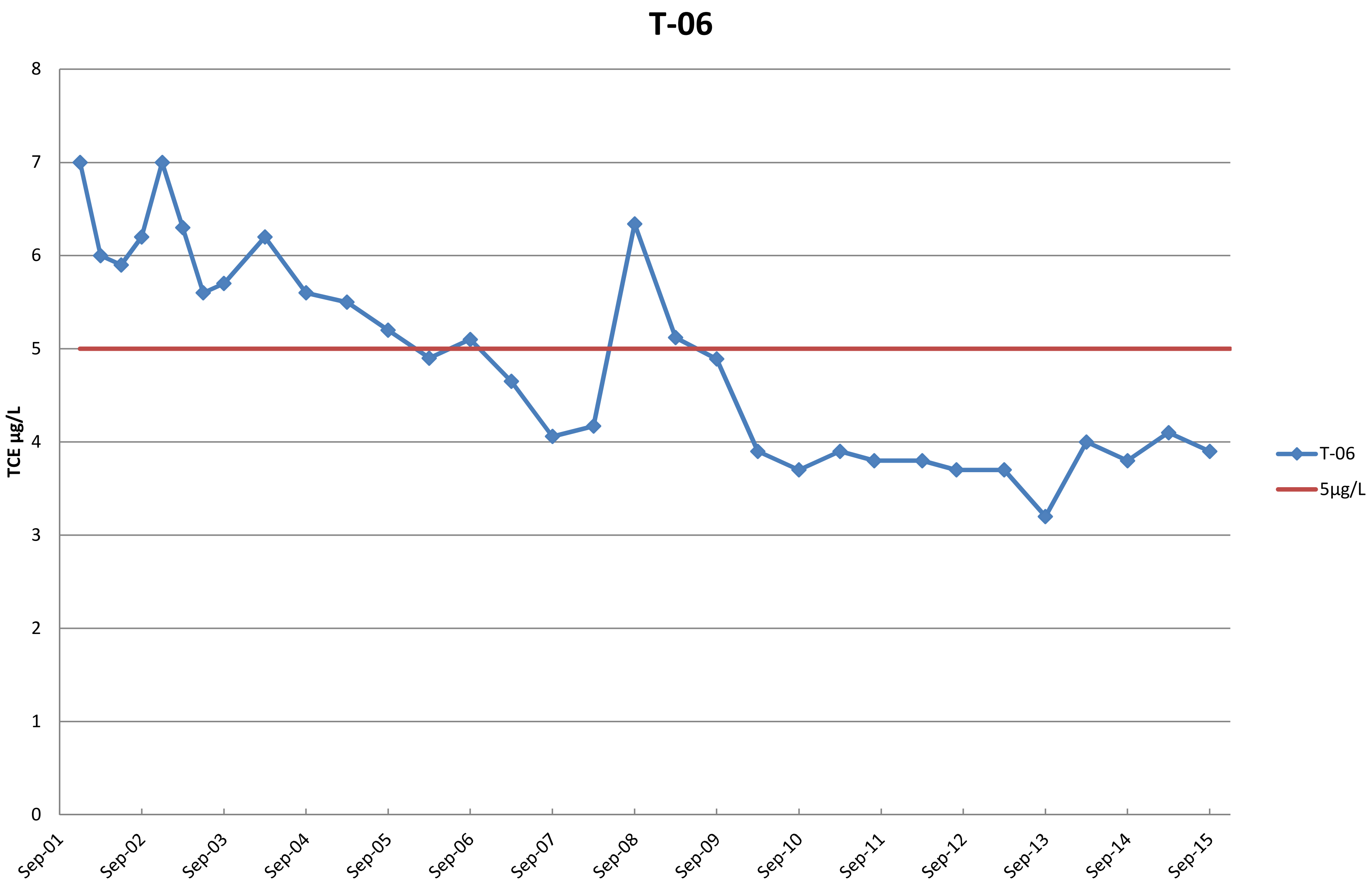

SW-MC-9
TCE µg/L
6
5
4
3
2
1
0
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
SW-MC-9
5µg/L

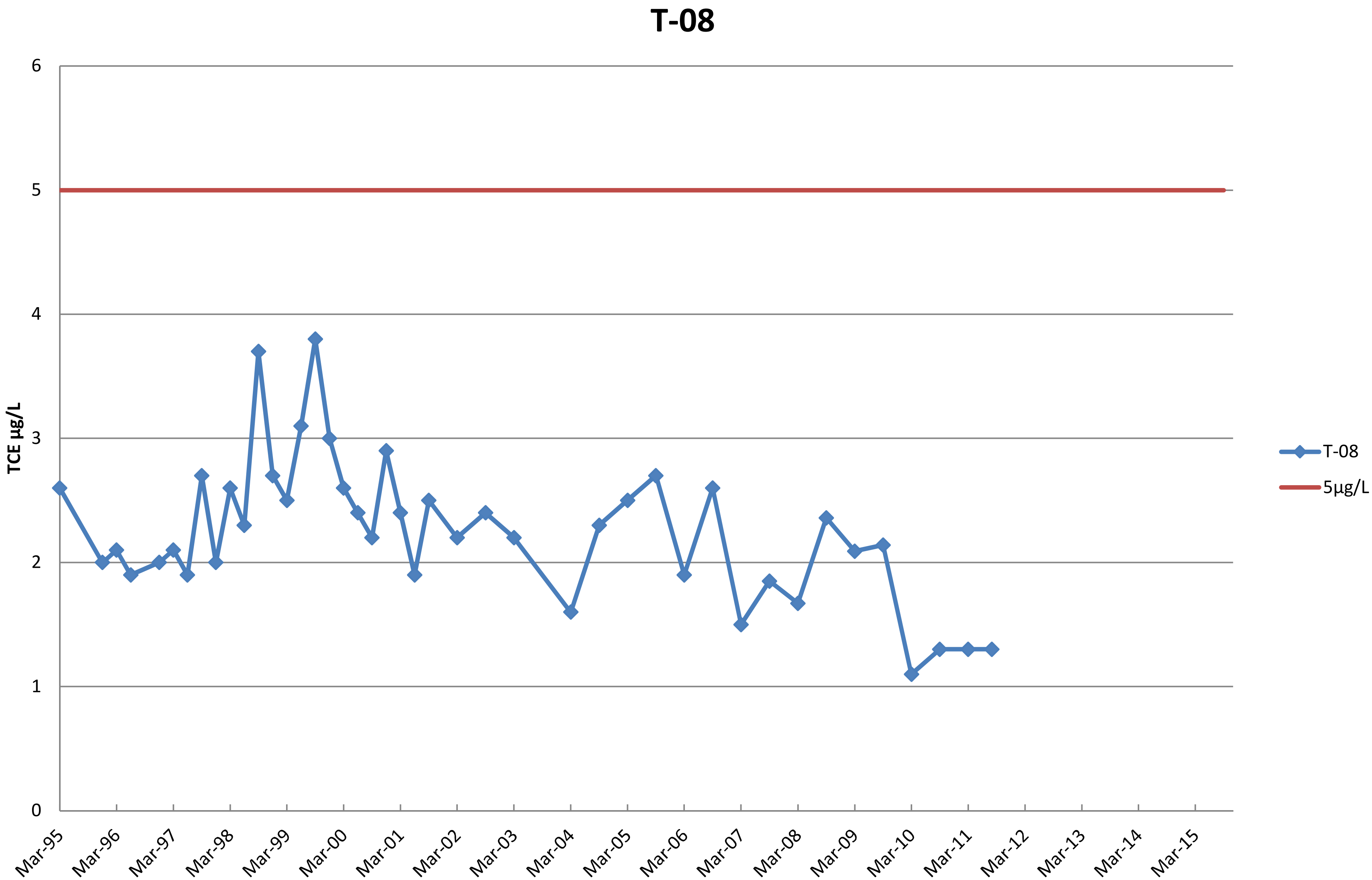

T-04
TCE µg/L
90
80
70
60
50
40
30
20
10
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
T-04
5µg/L

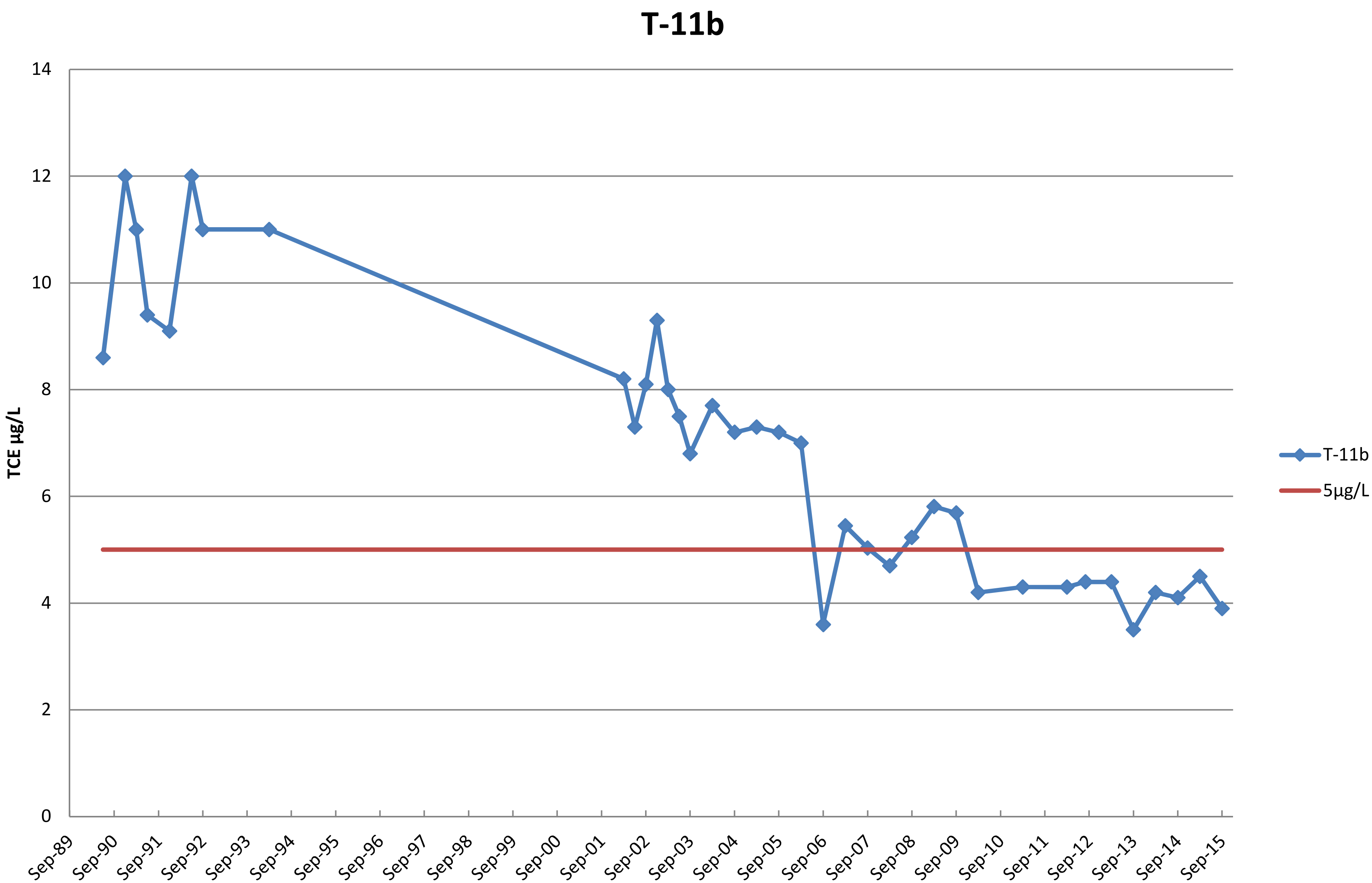
T-04 (2004 - 2015)

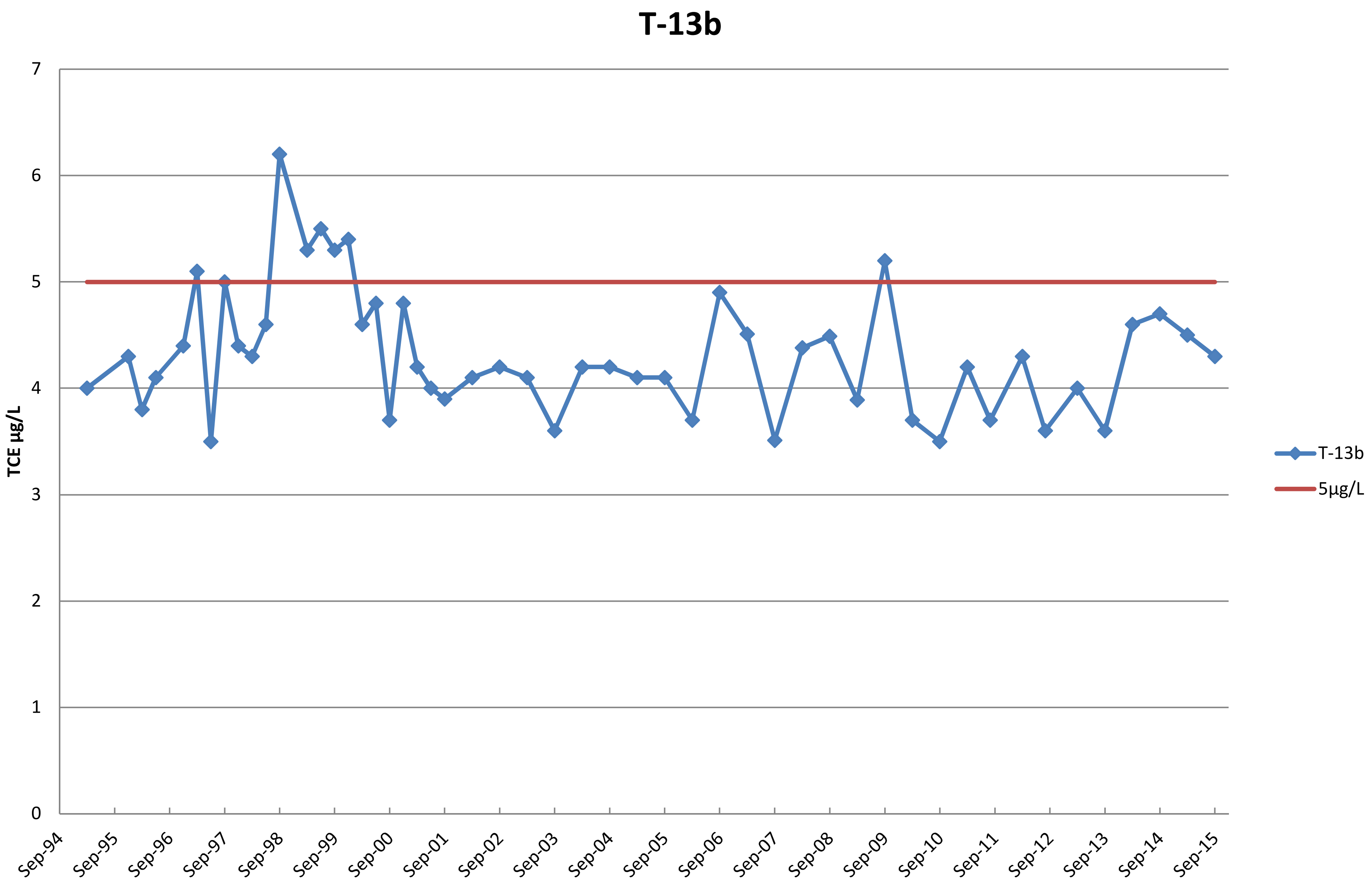


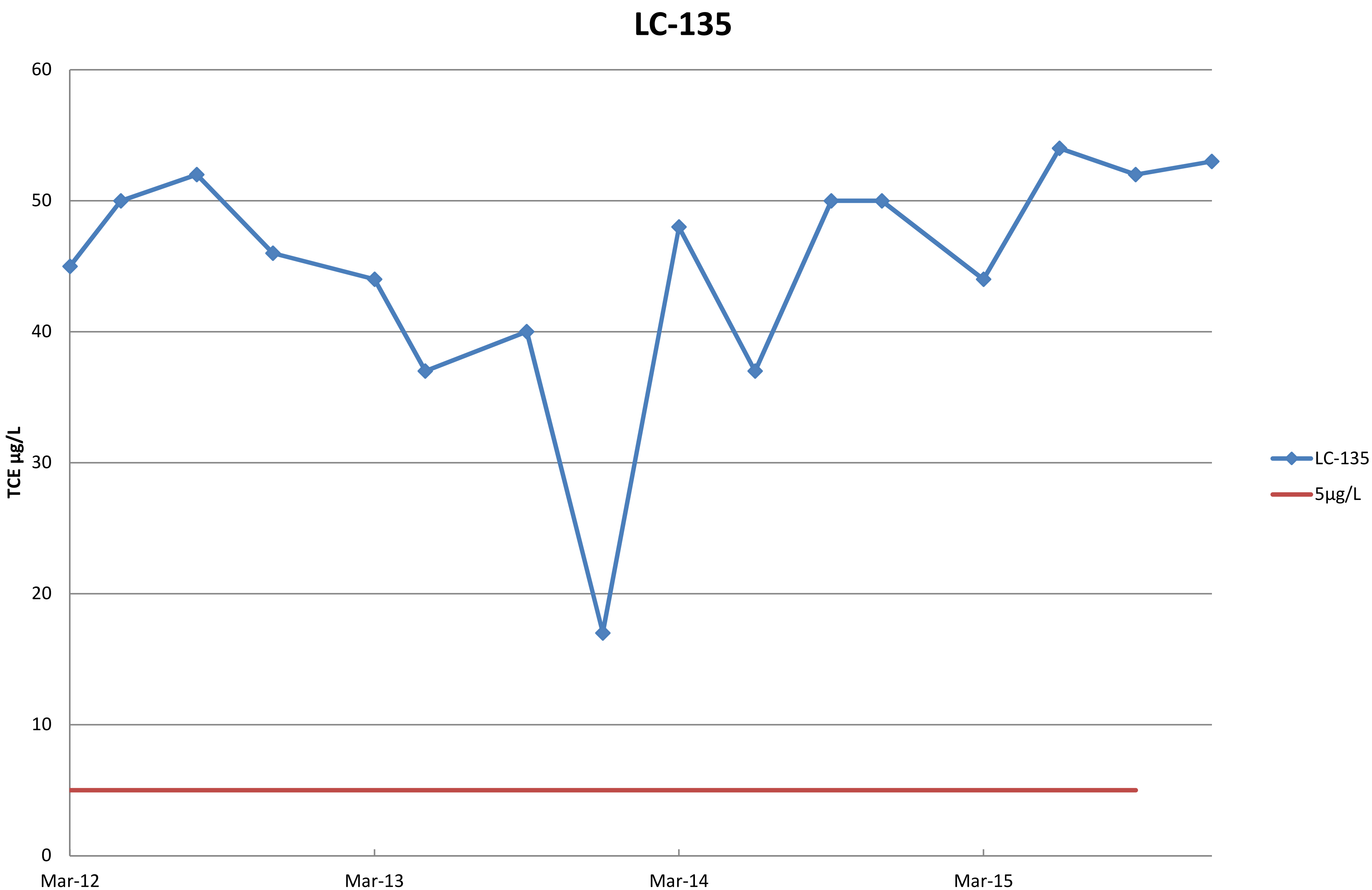

T-05
6
5
4
3
2
1
0
TCE µg/L
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
T-05
5µg/L

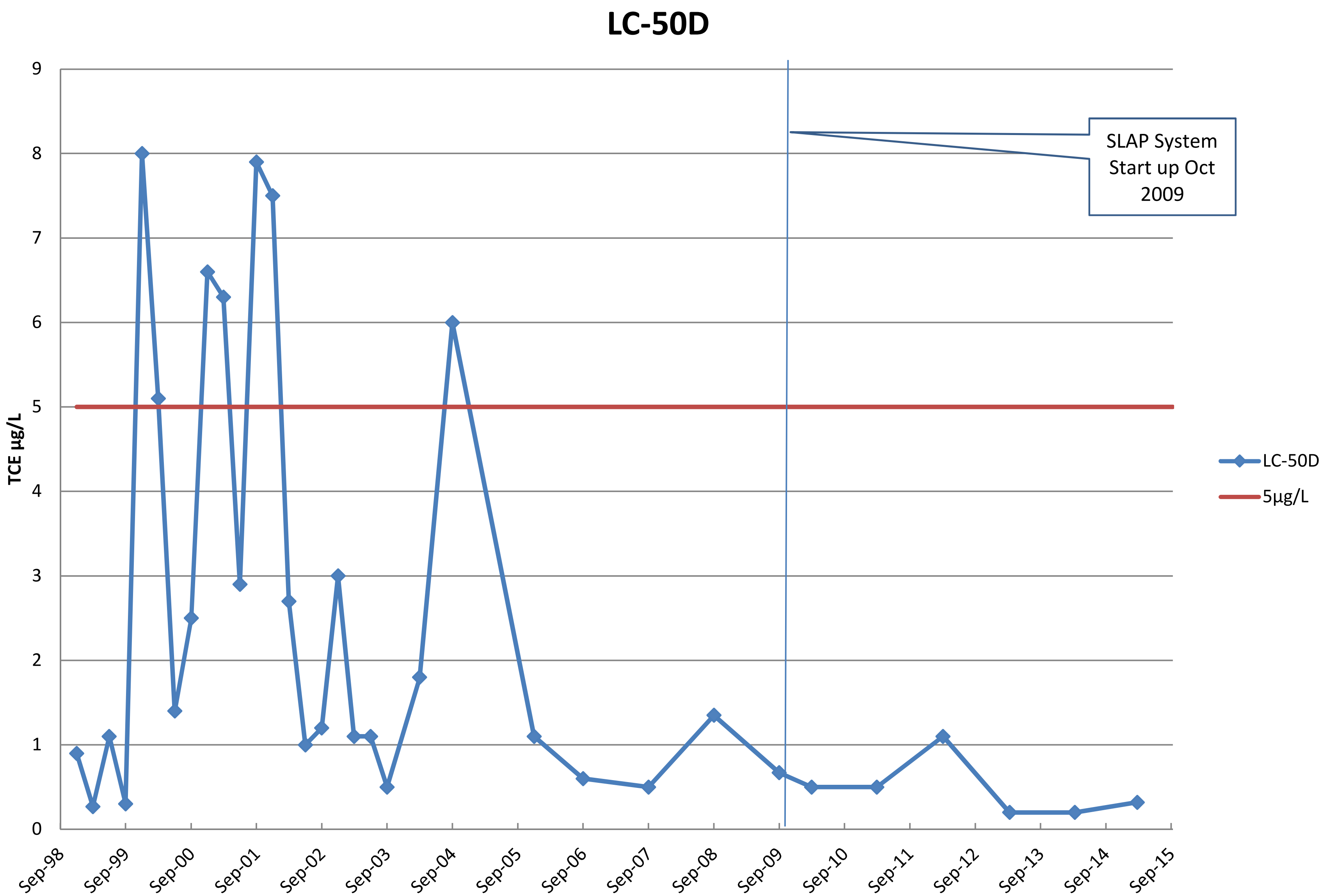

T-06
8
7
6
5
4
3
2
1
0
TCE µg/L
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
T-06
5µg/L

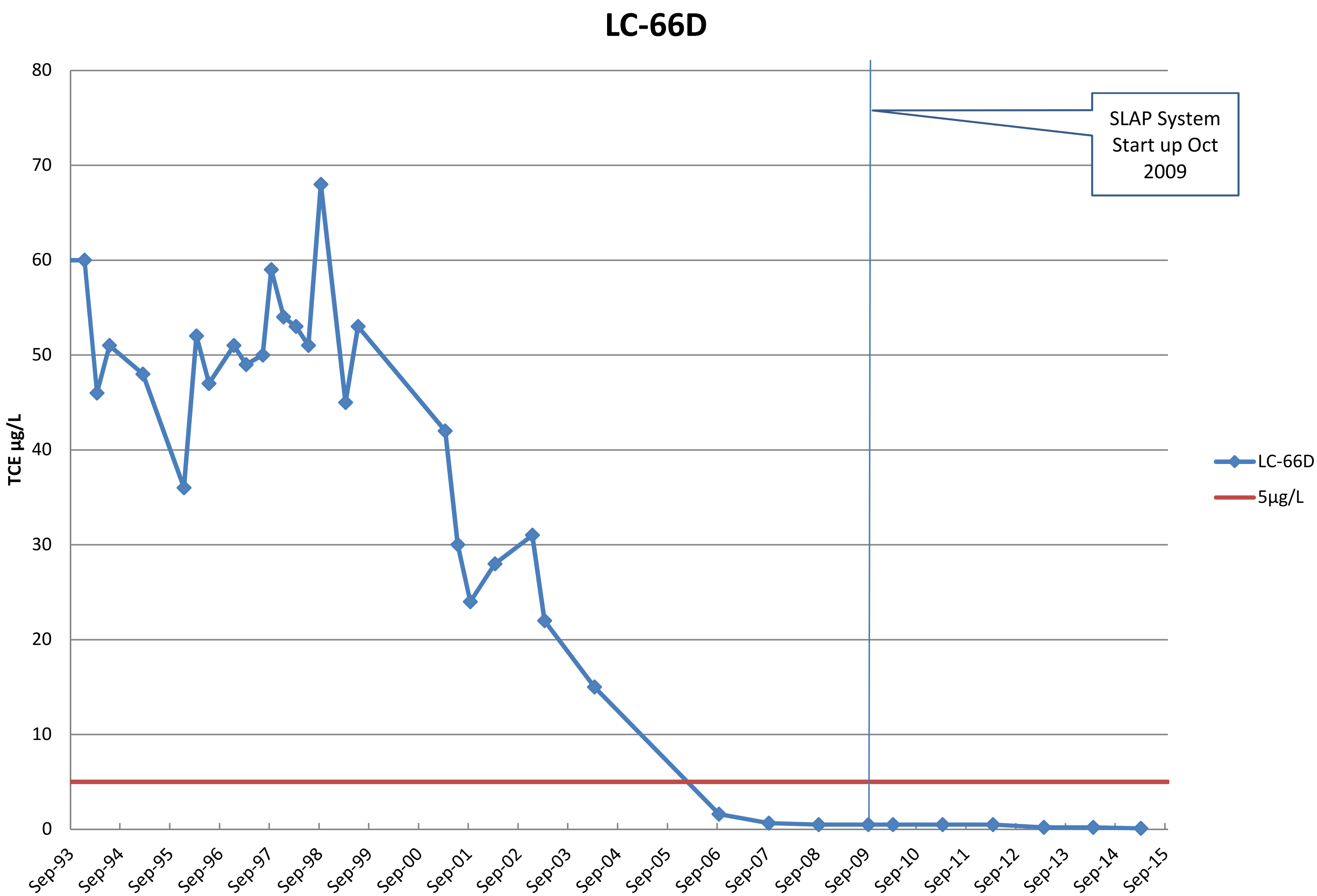

T-08
TCE µg/L
0
1
2
3
4
5
6
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
T-08
5µg/L

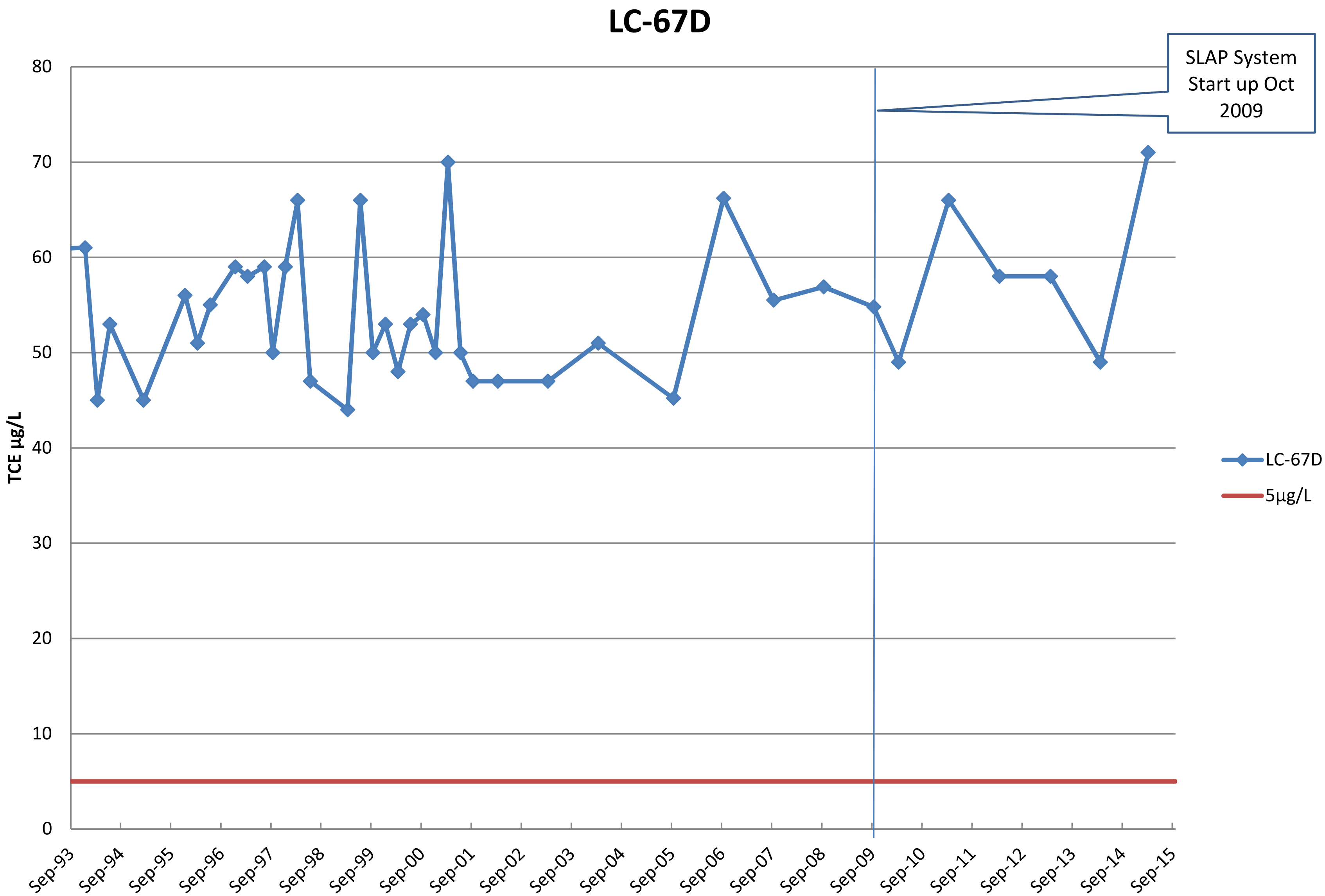

T-11b
14
12
10
8
6
4
2
0
TCE µg/L
Sep-89
Sep-90
Sep-91
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
T-11b
5µg/L


T-13b
TCE µg/L
0
1
2
3
4
5
6
7
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
T-13b
5µg/L

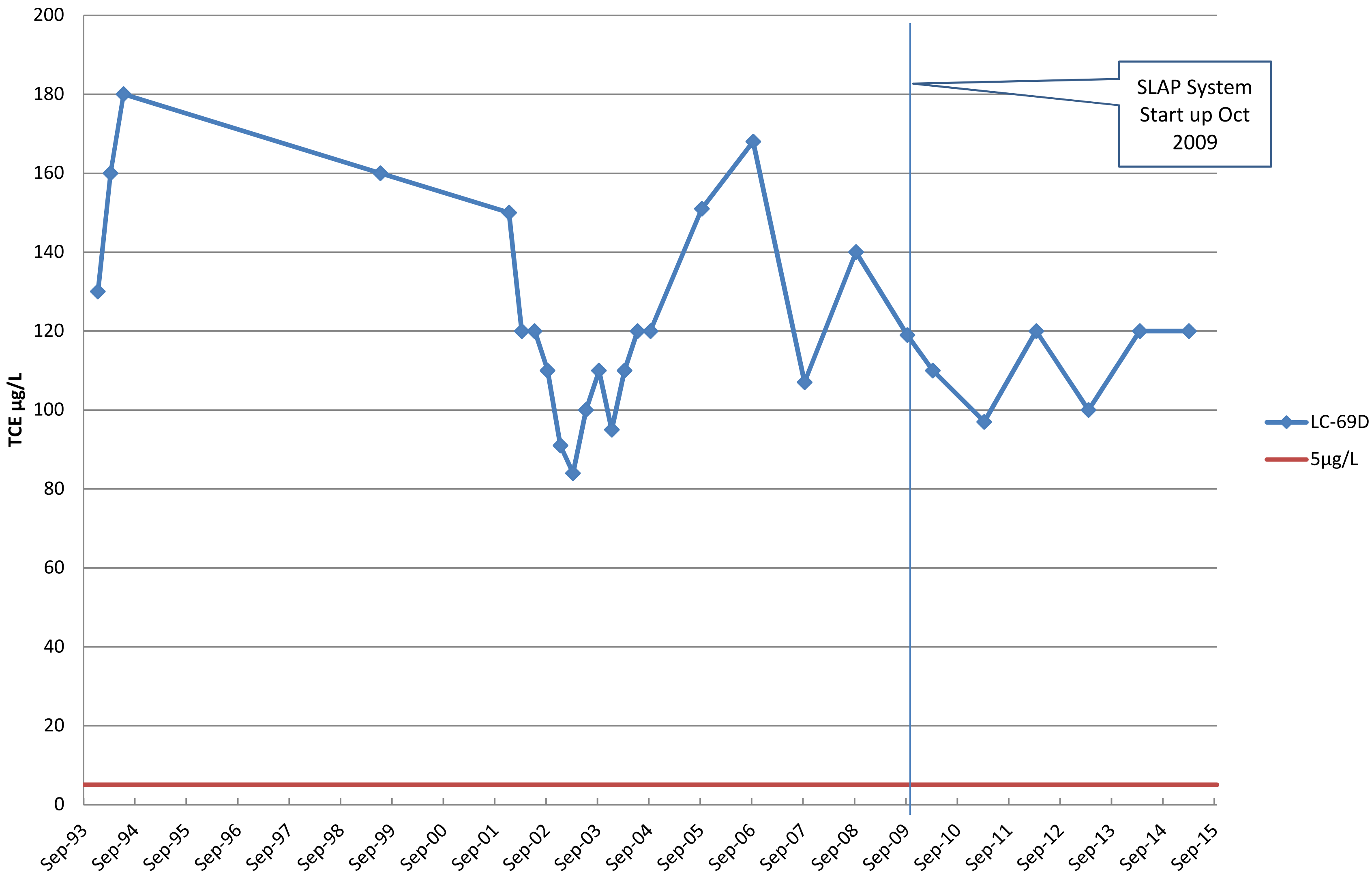

LC-135
60
50
40
30
20
10
0
TCE µg/L
Mar-12
Mar-13
Mar-14
Mar-15
LC-135
5µg/L

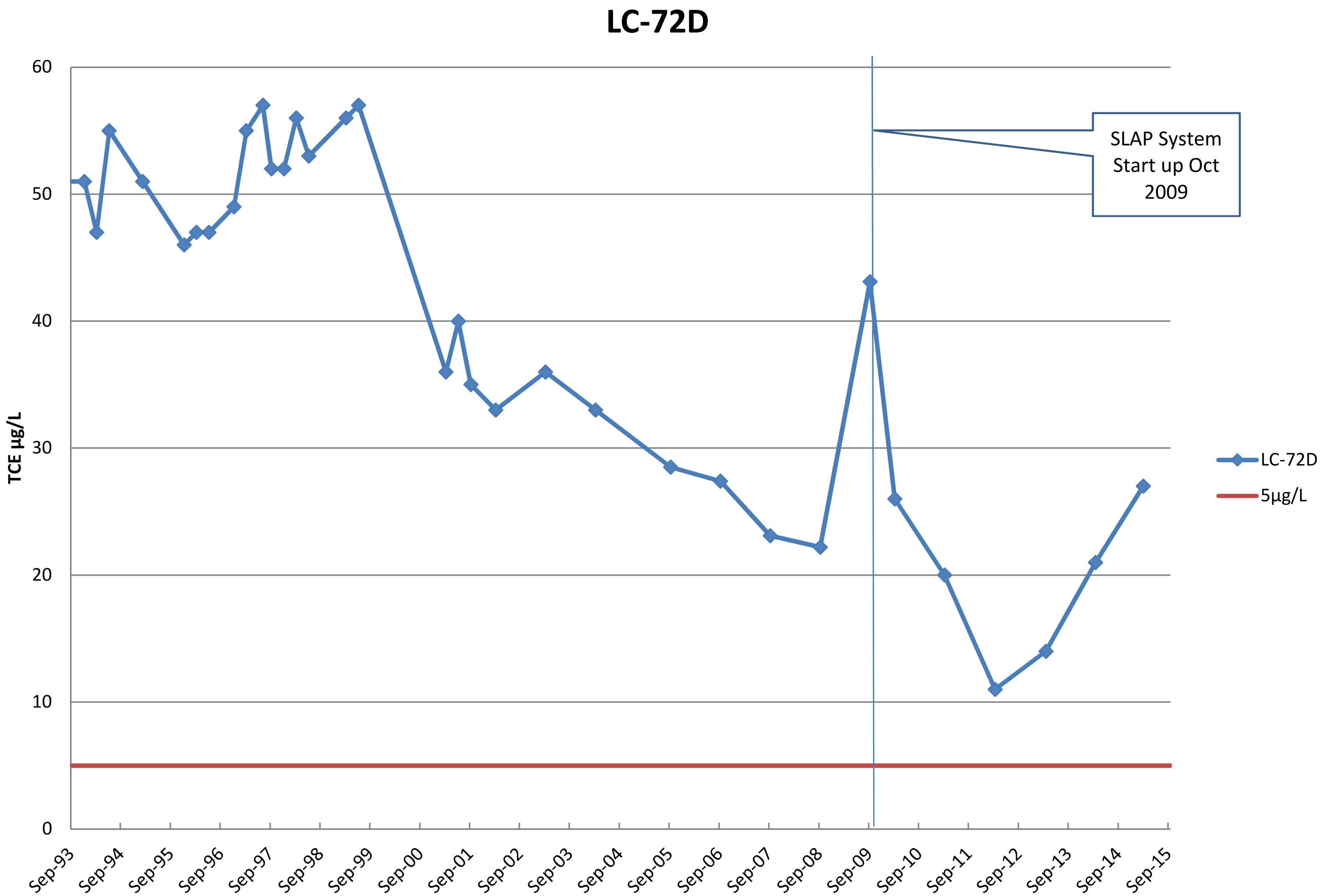

LC-50D
TCE µg/L
9
8
7
6
5
4
3
2
1
0
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
SLAP System Start up Oct 2009
LC-50D
5µg/L

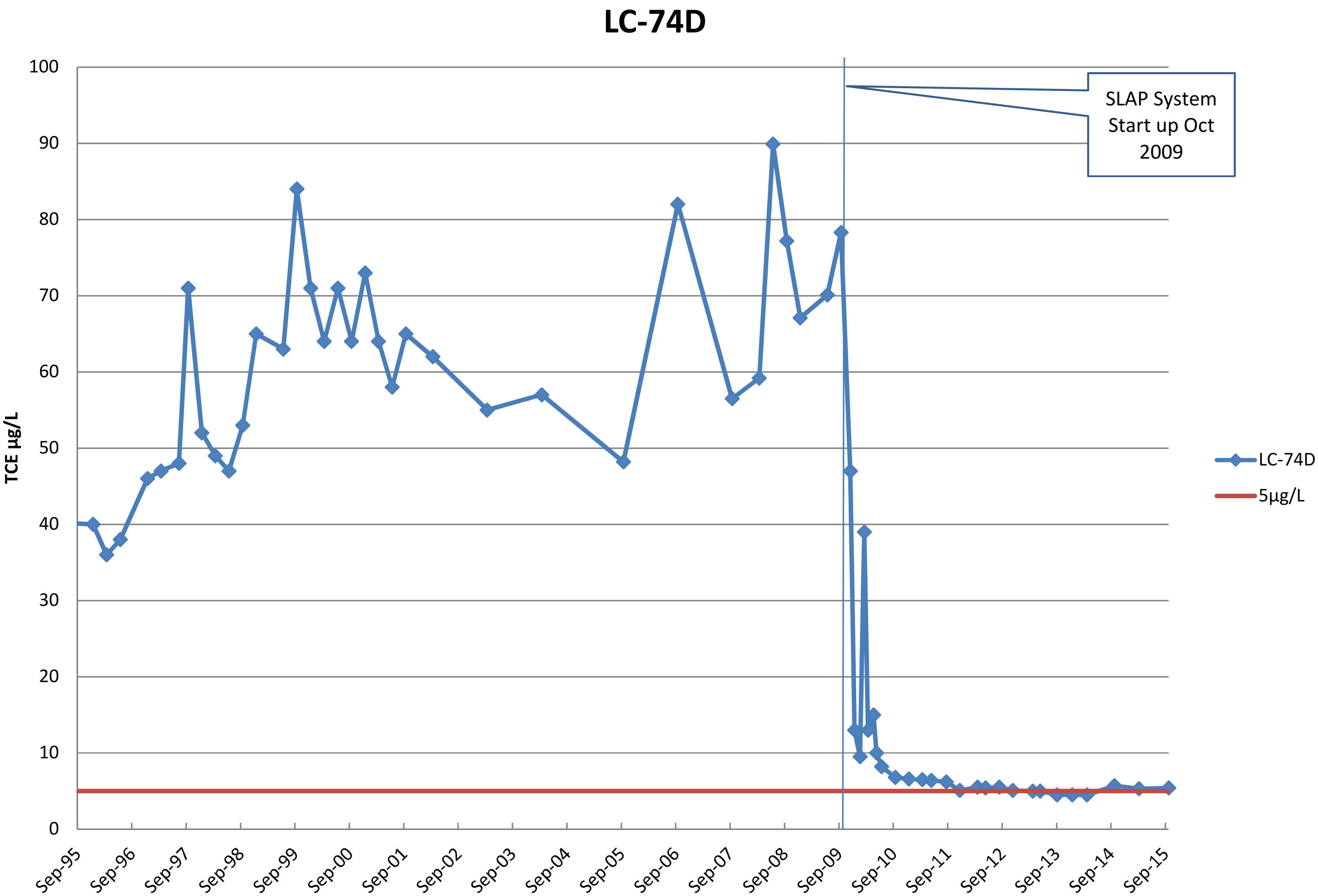

LC-66D
TCE µg/L
0
10
20
30
40
50
60
70
80
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
SLAP System Start up Oct 2009
LC-66D
5µg/L

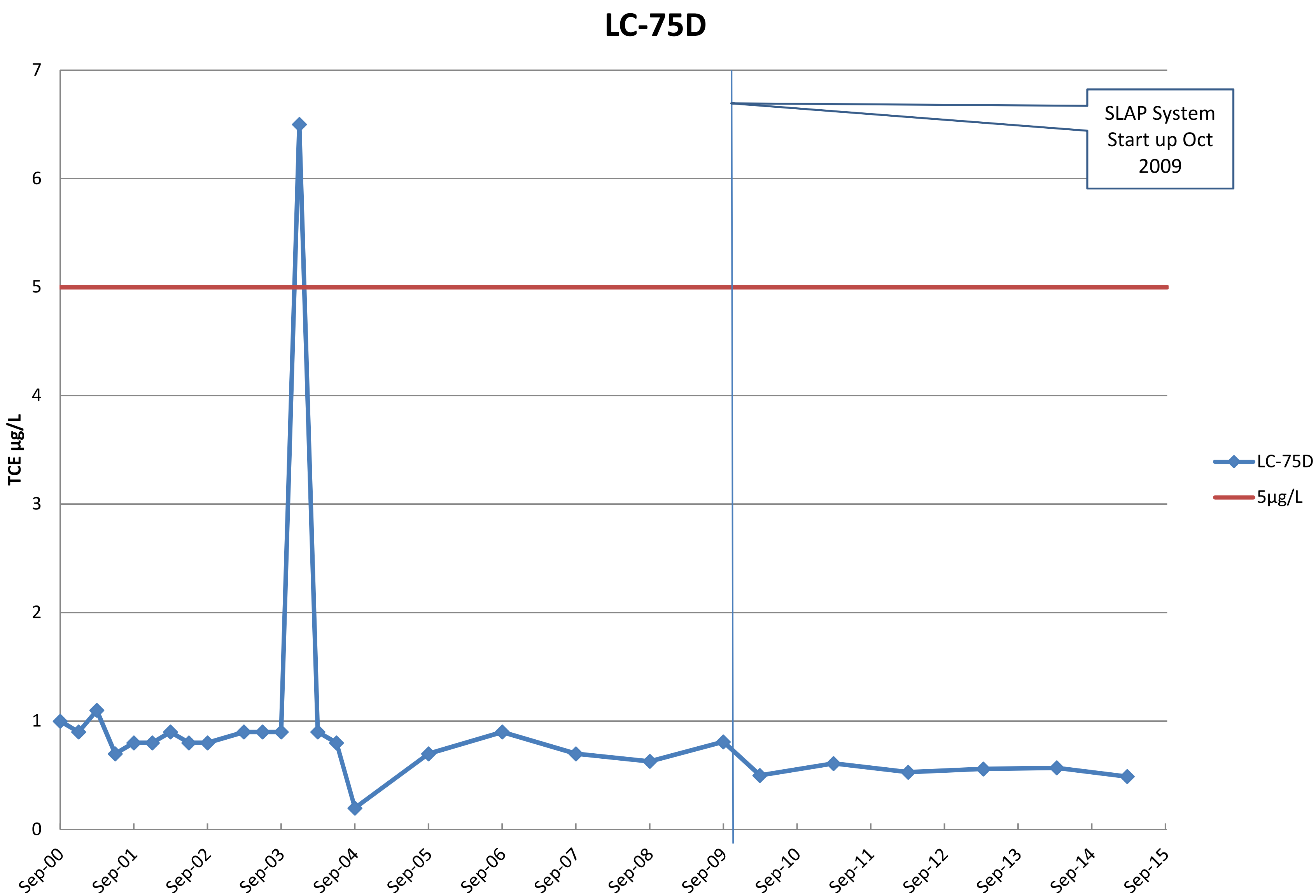

LC-67D
SLAP System Start up Oct 2009
TCE µg/L
0
10
20
30
40
50
60
70
80
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-67D
5µg/L

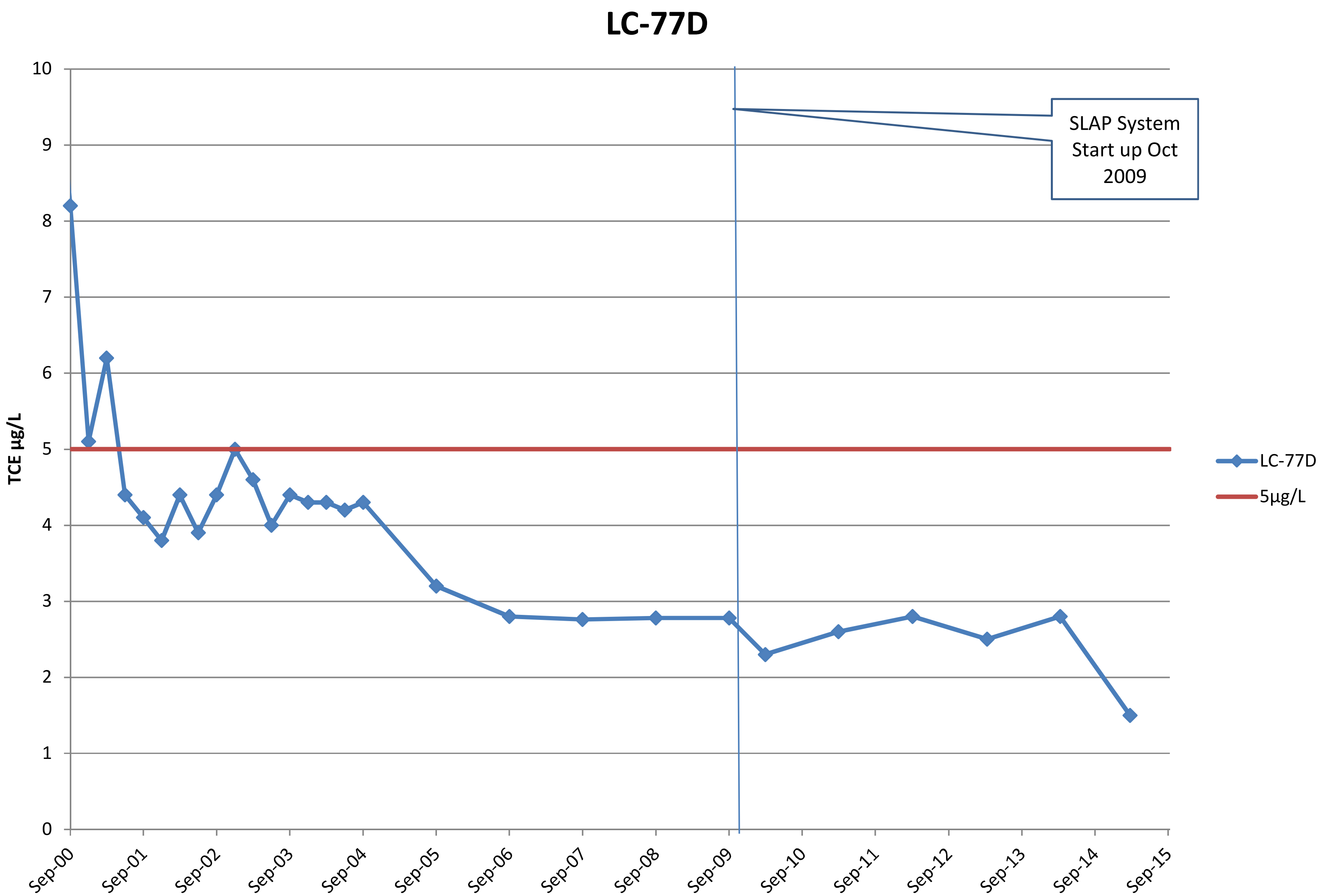
LC-69D

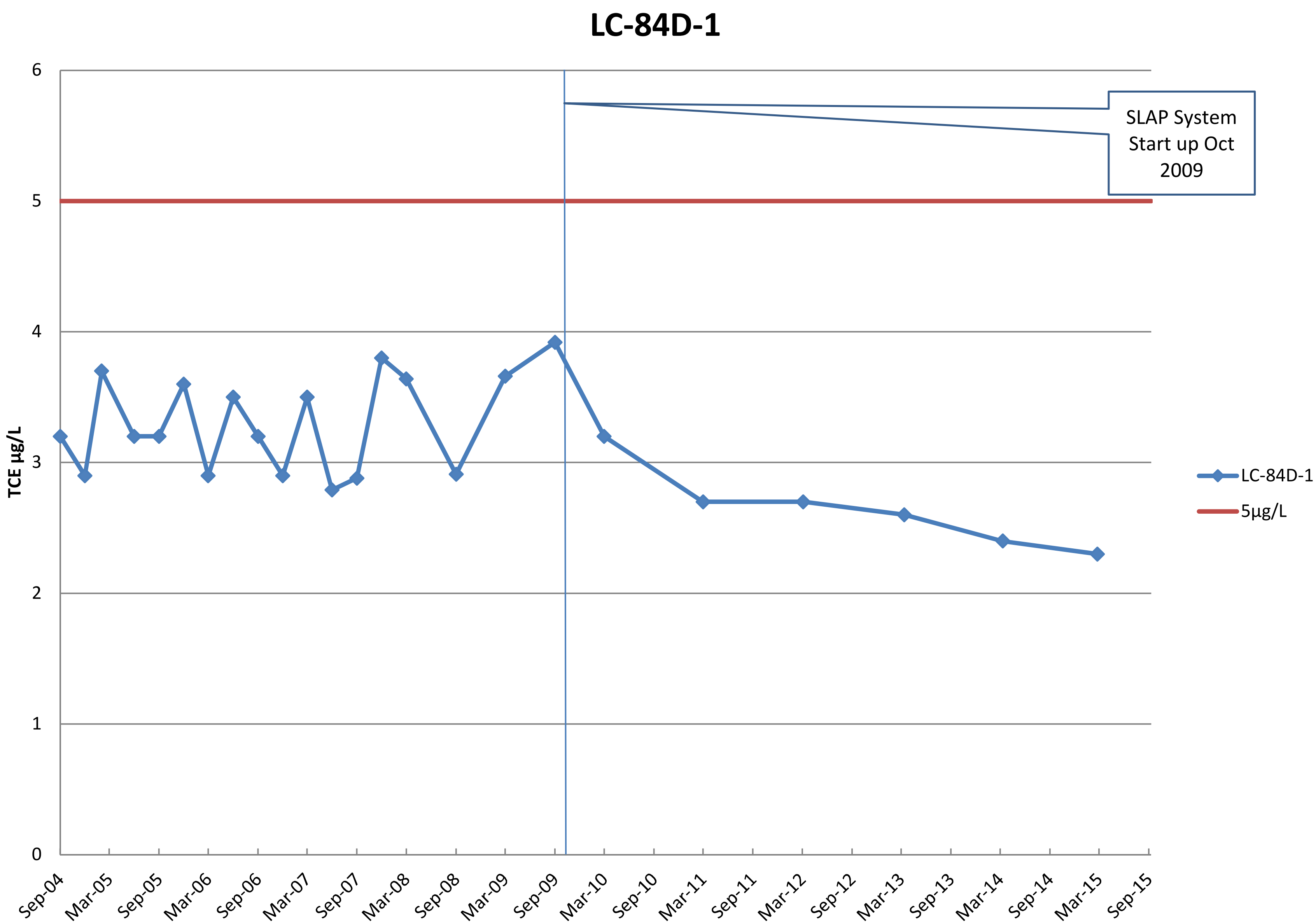

200
180
160
140
120
100
80
60
40
20
0
TCE µg/L
SLAP System Start up Oct 2009
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-69D
5µg/L

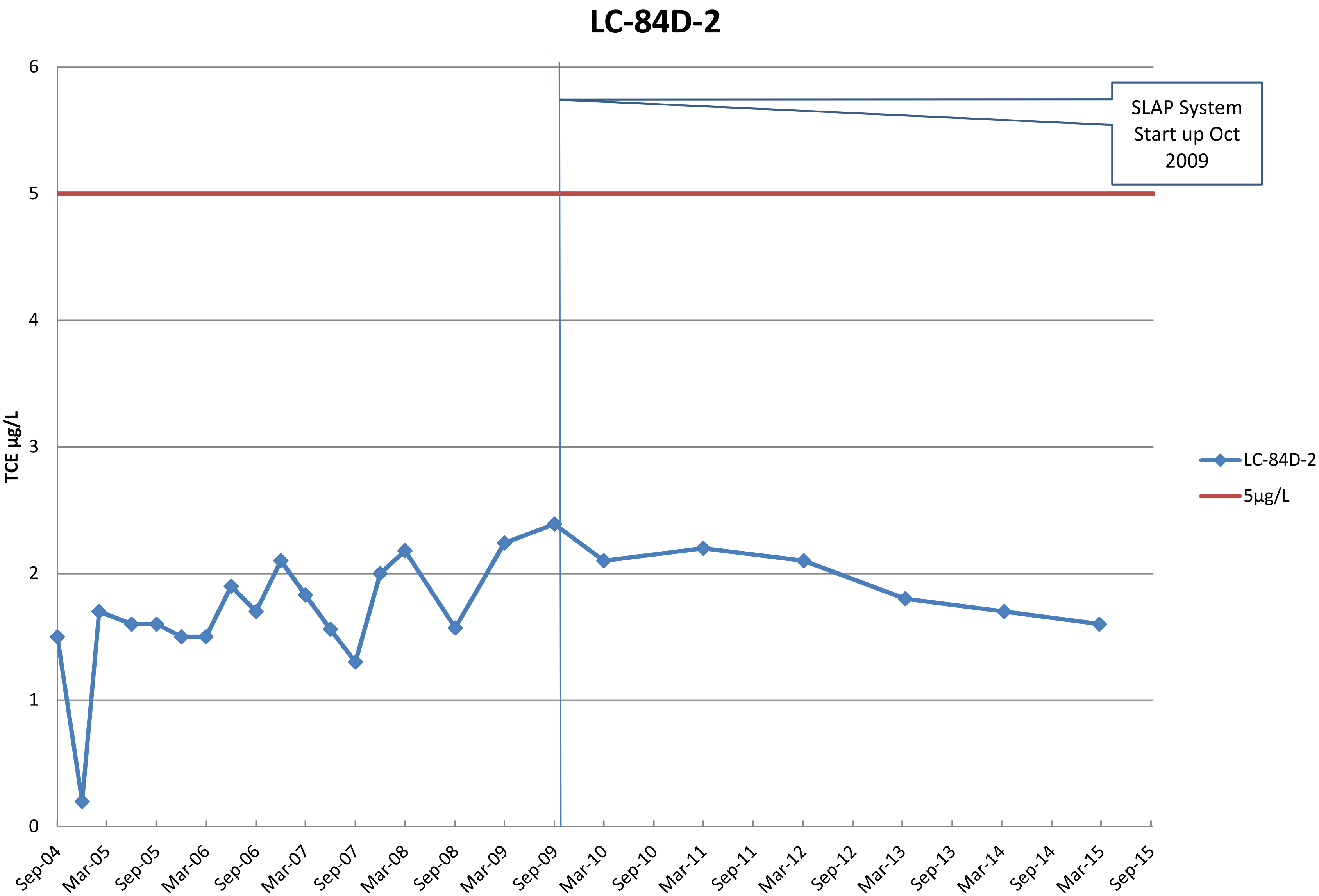

LC-72D
60
50
40
30
20
10
0
TCE µg/L
SLAP System Start up Oct 2009
LC-72D
5µg/L
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15

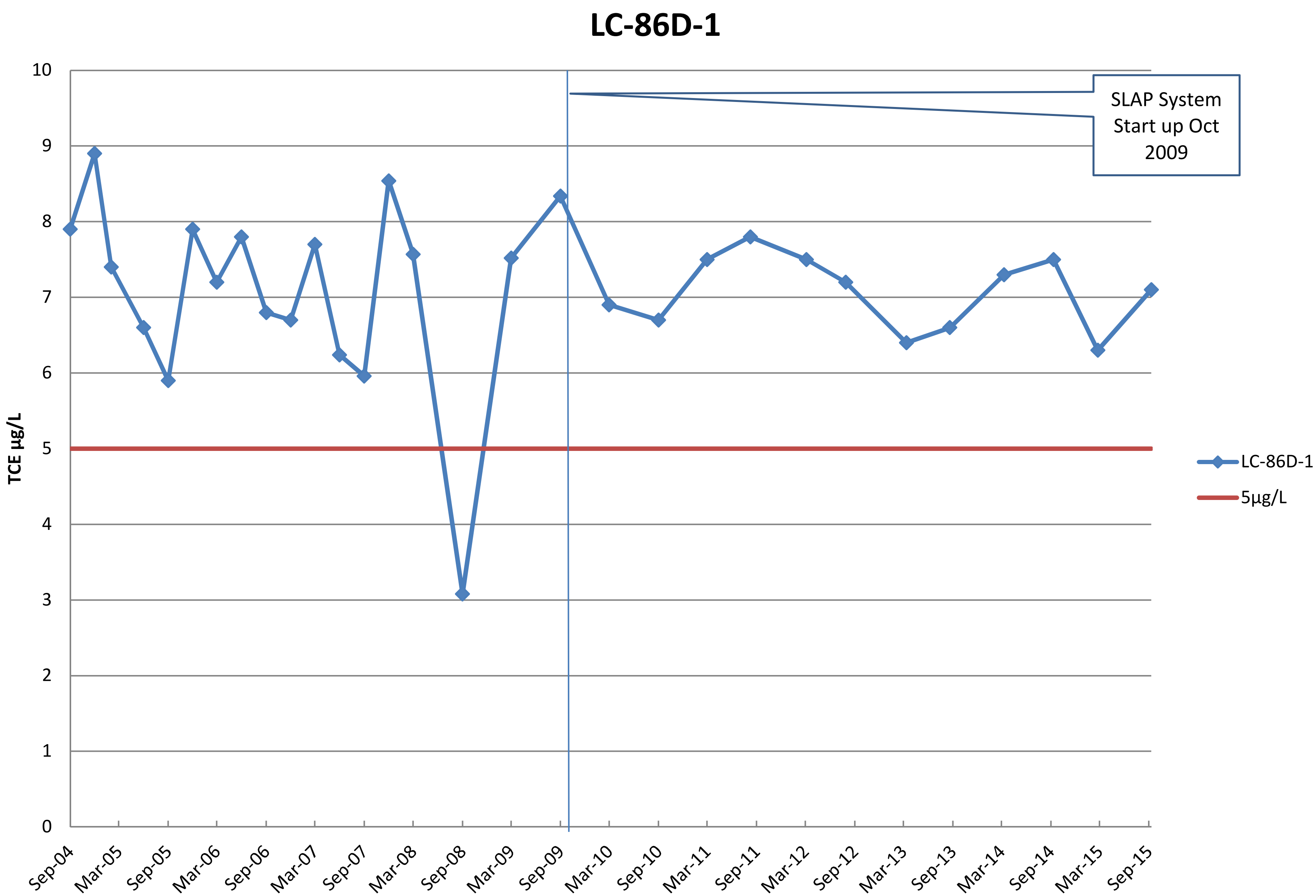

LC-74D
TCE µg/L
100
90
80
70
60
50
40
30
20
10
0
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
SLAP System Start up Oct 2009
LC-74D
5µg/L

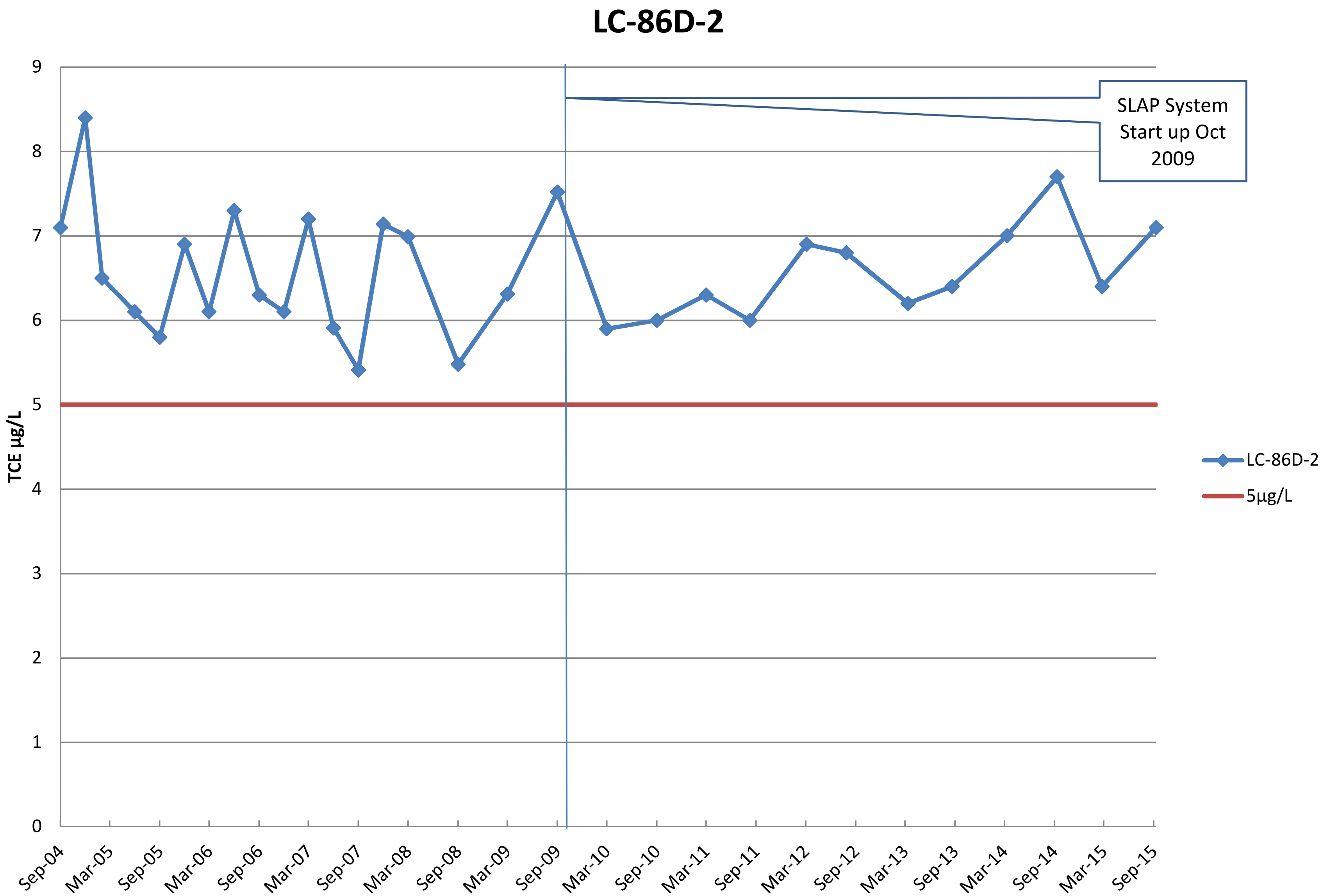

LC-75D
TCE µg/L
7
6
5
4
3
2
1
0
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
SLAP System Start up Oct 2009
LC-75D
5µg/L

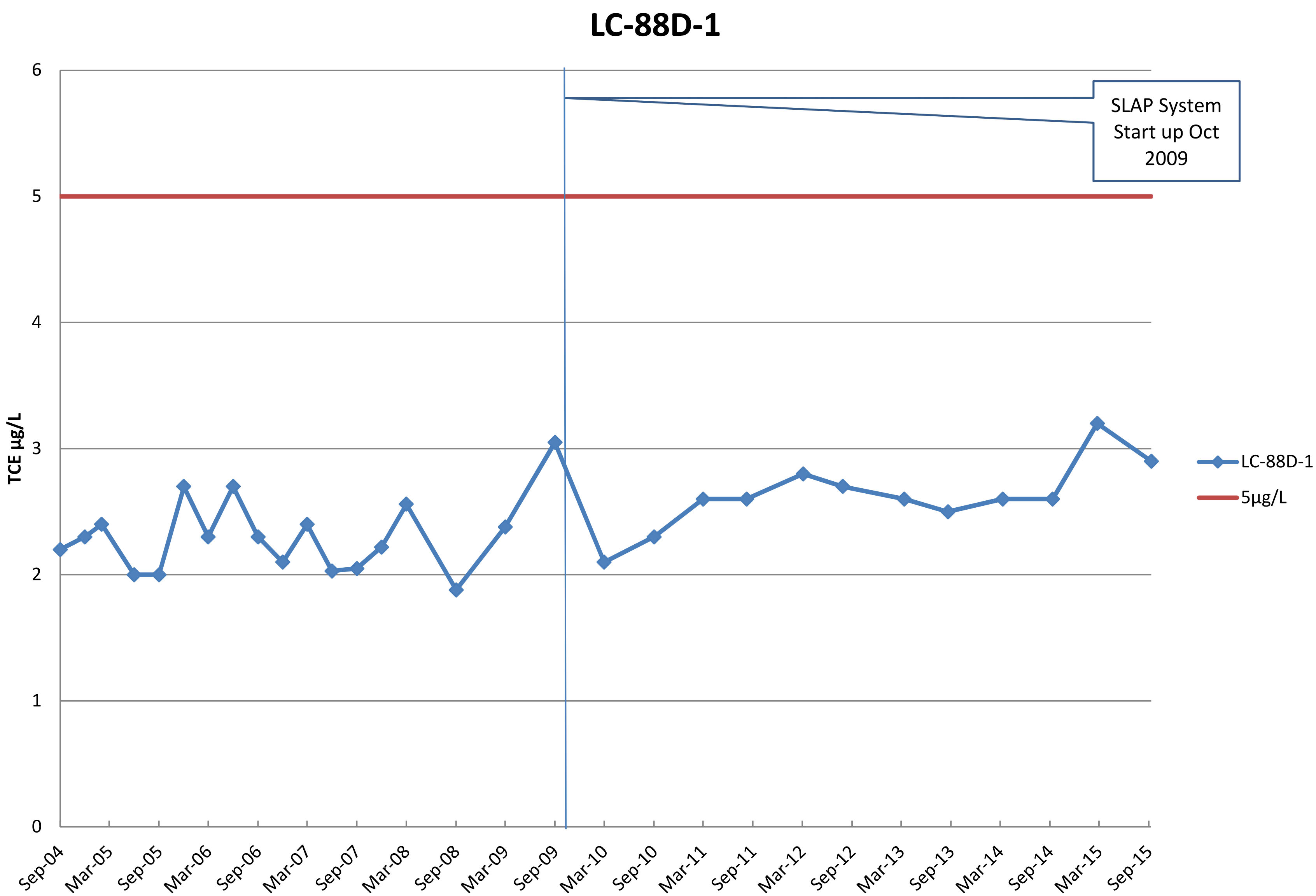

LC-77D
SLAP System Start up Oct 2009
TCE µg/L
10
9
8
7
6
5
4
3
2
1
0
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
LC-77D
5µg/L

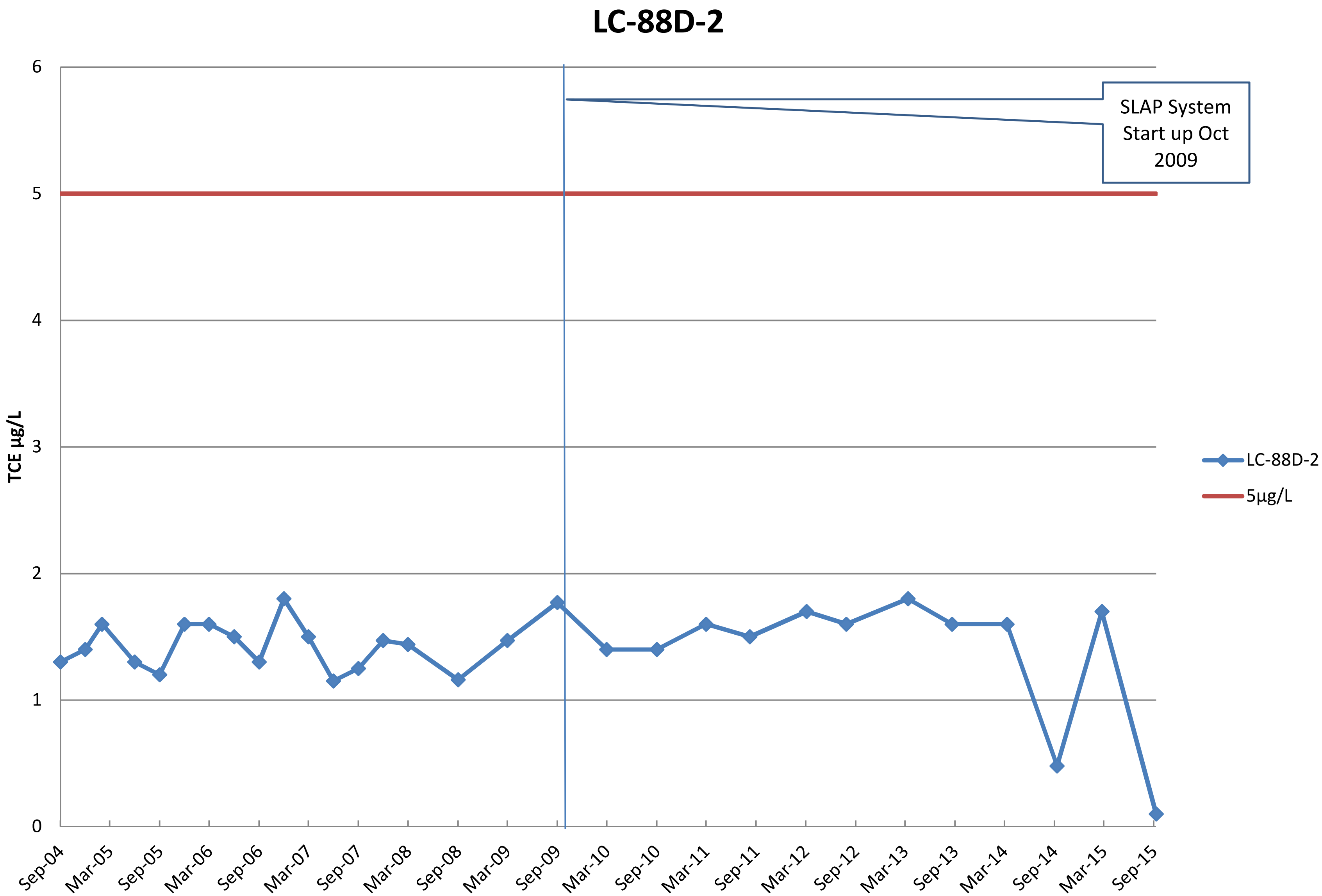

LC-84D-1
SLAP System Start up Oct 2009
TCE µg/L
6
5
4
3
2
1
0
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-84D-1
5µg/L

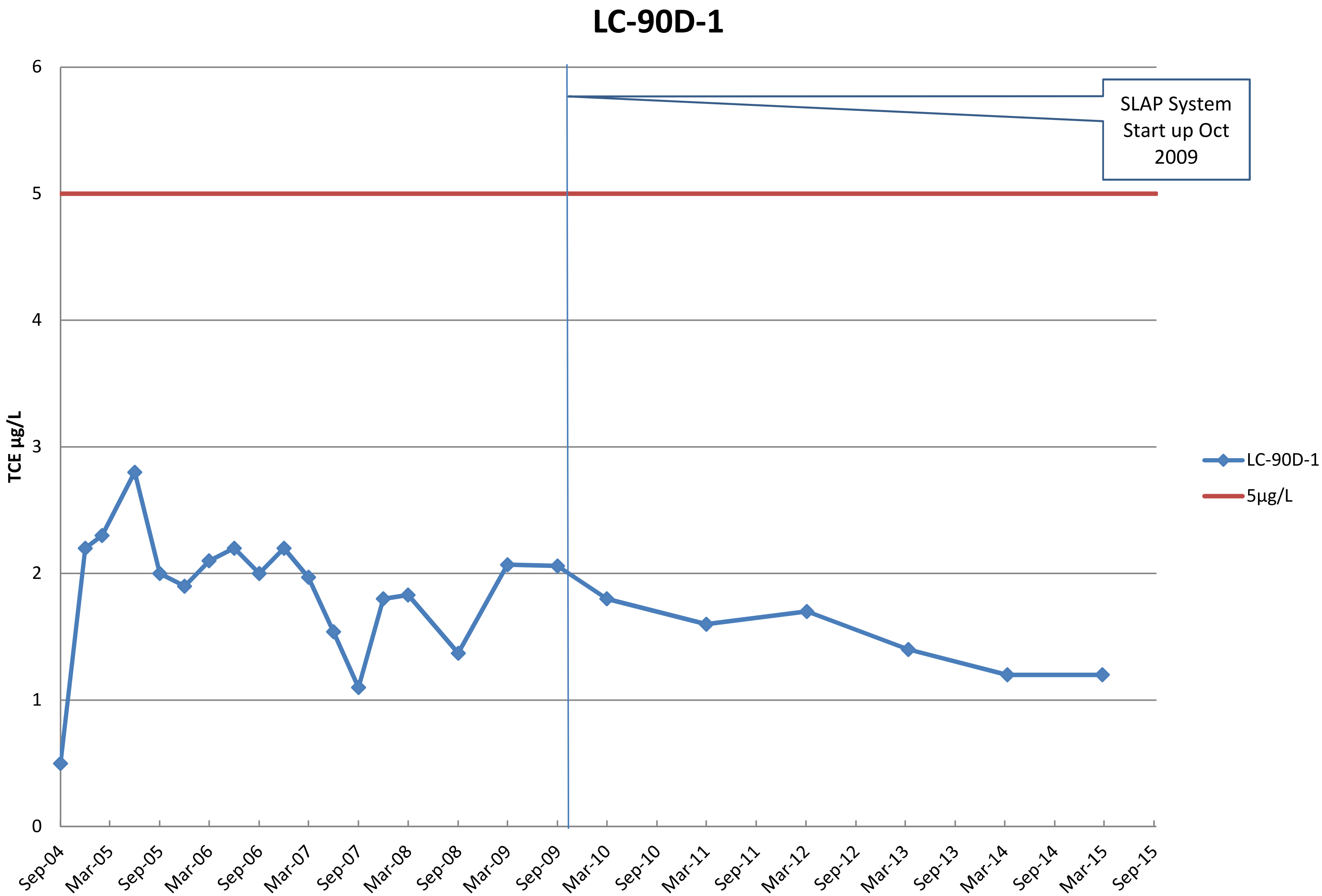

LC-84D-2
SLAP System Start up Oct 2009
TCE µg/L
0
1
2
3
4
5
6
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-84D-2
5µg/L

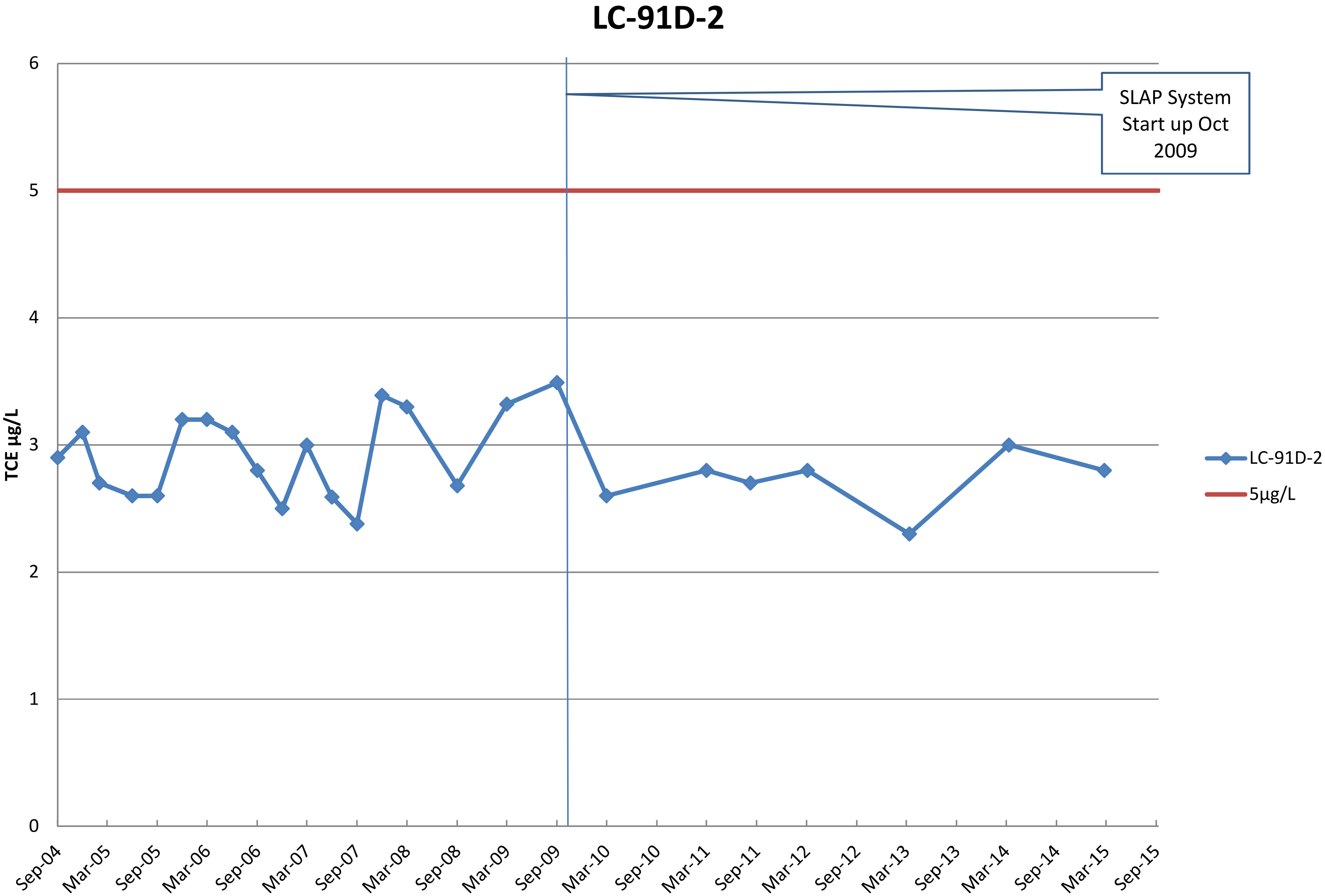

LC-86D-1
TCE µg/L
10
9
8
7
6
5
4
3
2
1
0
SLAP System Start up Oct 2009
LC-86D-1
5µg/L
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15

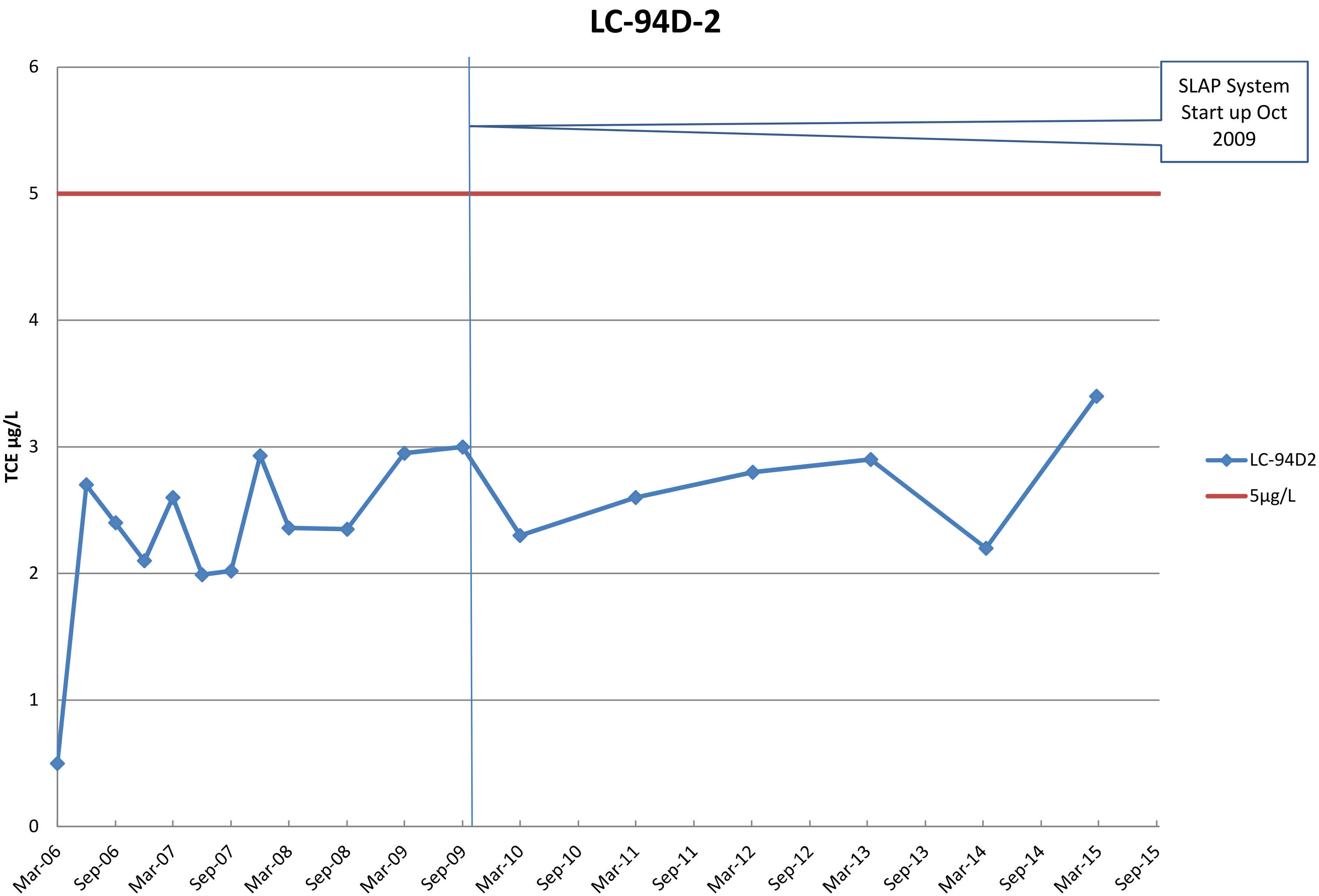

LC-86D-2
TCE µg/L
0
1
2
3
4
5
6
7
8
9
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
SLAP System Start up Oct 2009
LC-86D-2
5µg/L

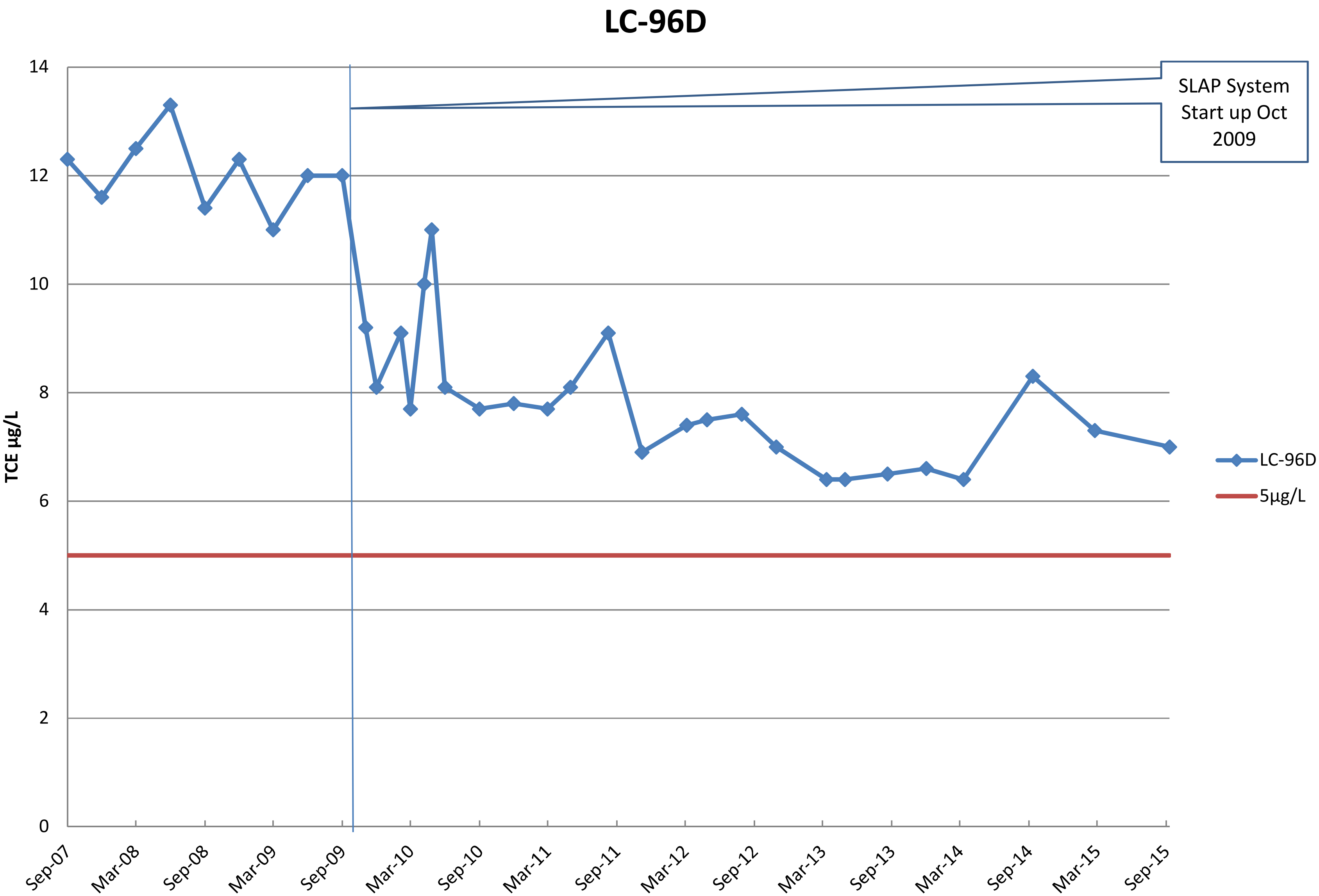

LC-88D-1
SLAP System Start up Oct 2009
TCE µg/L
0
1
2
3
4
5
6
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-88D-1
5µg/L


LC-88D-2
TCE µg/L
SLAP System Start up Oct 2009
0
1
2
3
4
5
6
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-88D-2
5µg/L

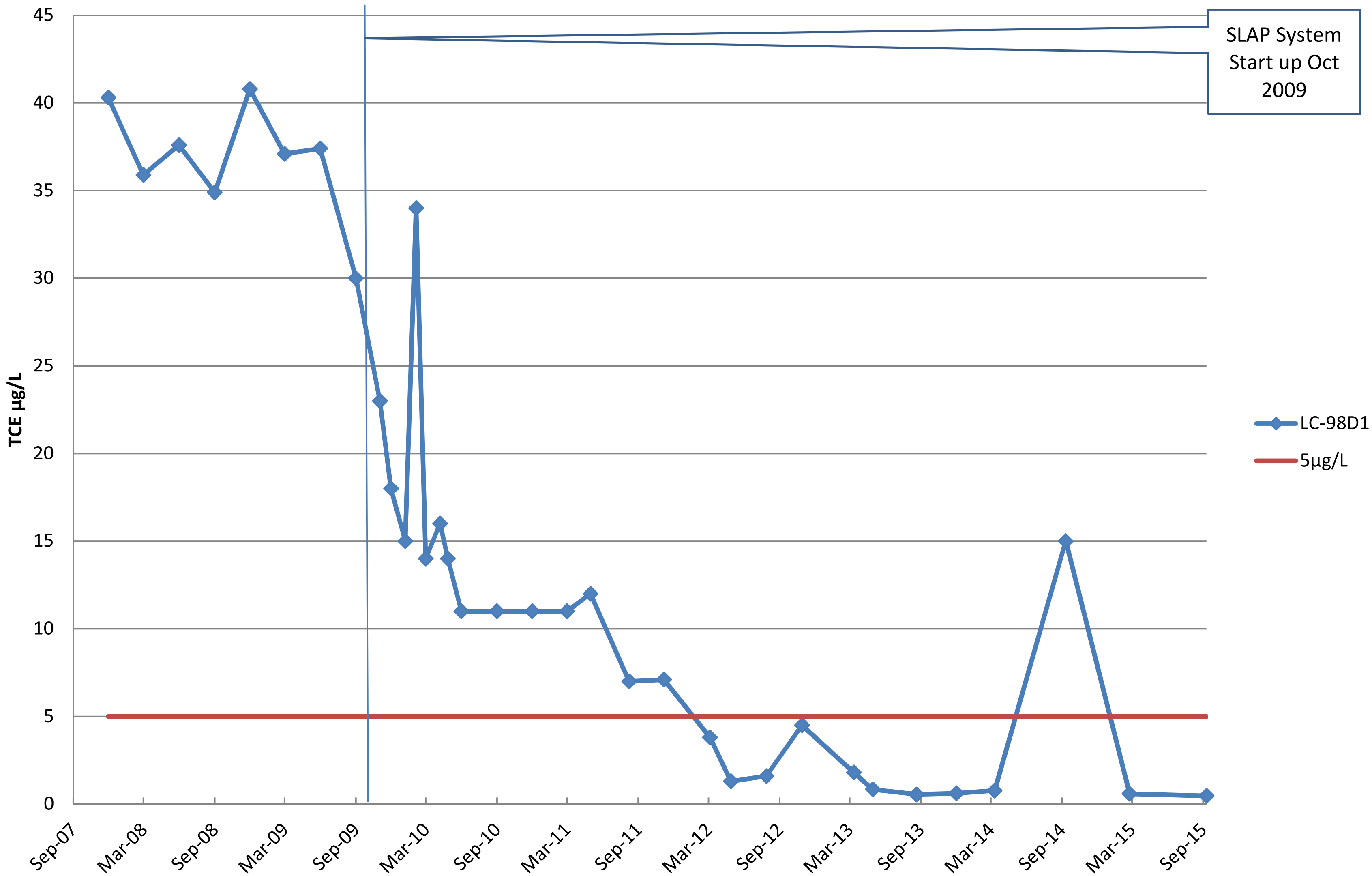

LC-90D-1
TCE µg/L
0
1
2
3
4
5
6
SLAP System Start up Oct 2009
LC-90D-1
5µg/L
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15


LC-91D-2
TCE µg/L
0
1
2
3
4
5
6
SLAP System Start up Oct 2009
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-91D-2
5µg/L

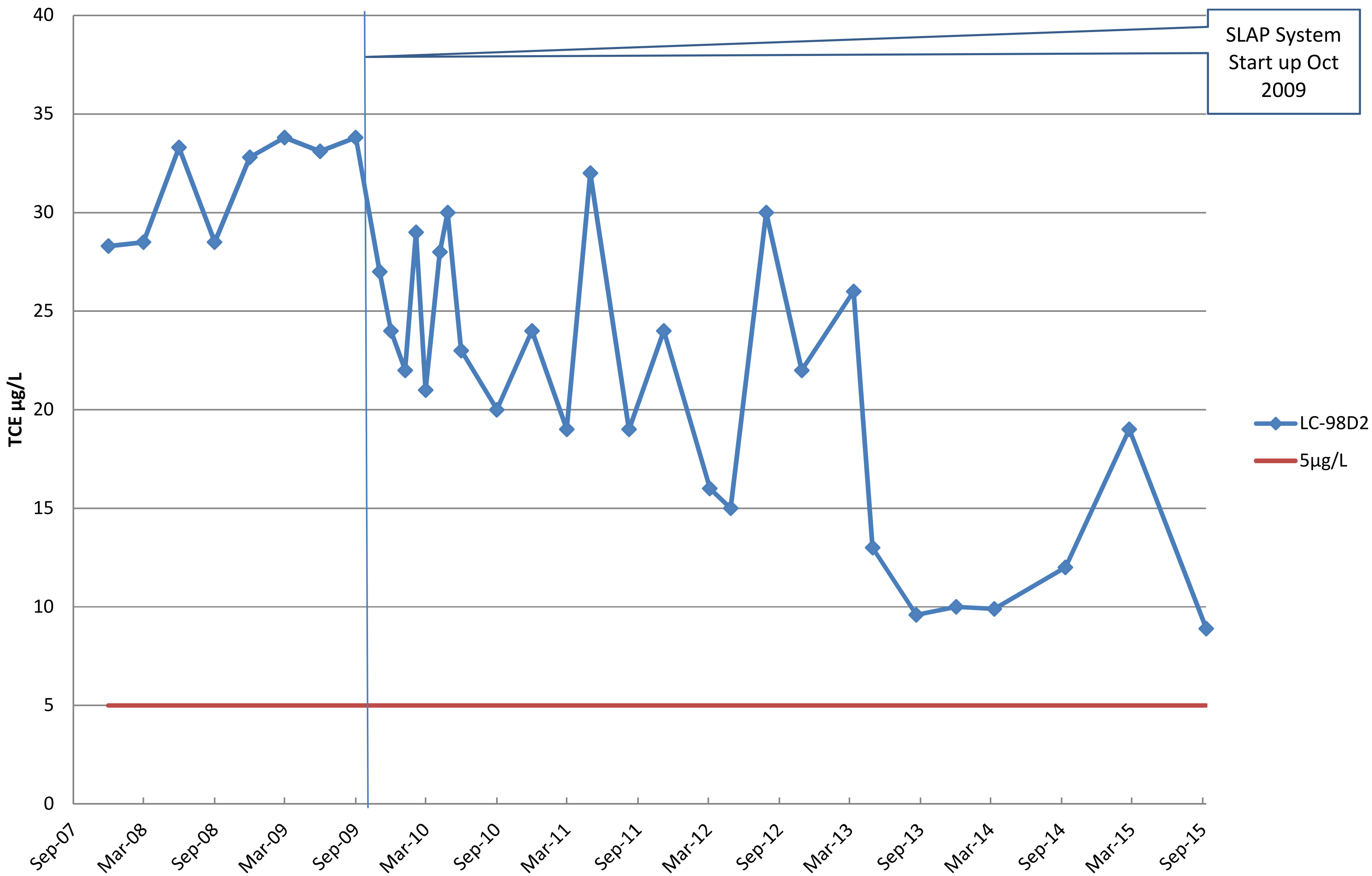

LC-94D-2
SLAP System Start up Oct 2009
TCE µg/L
0
1
2
3
4
5
6
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-94D2
5µg/L

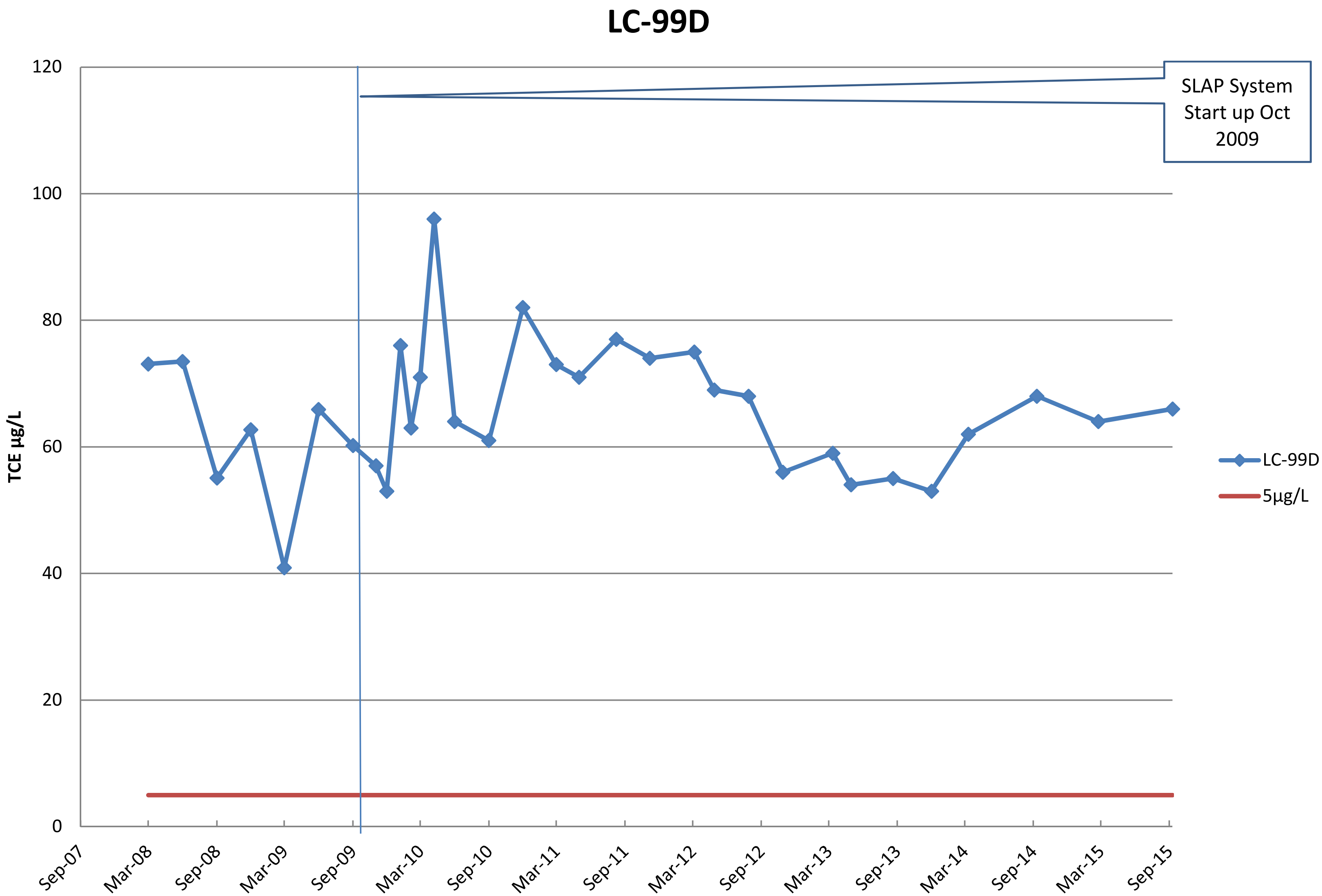

LC-96D
TCE µg/L
14
12
10
8
6
4
2
0
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
SLAP System Start up Oct 2009
LC-96D
5µg/L

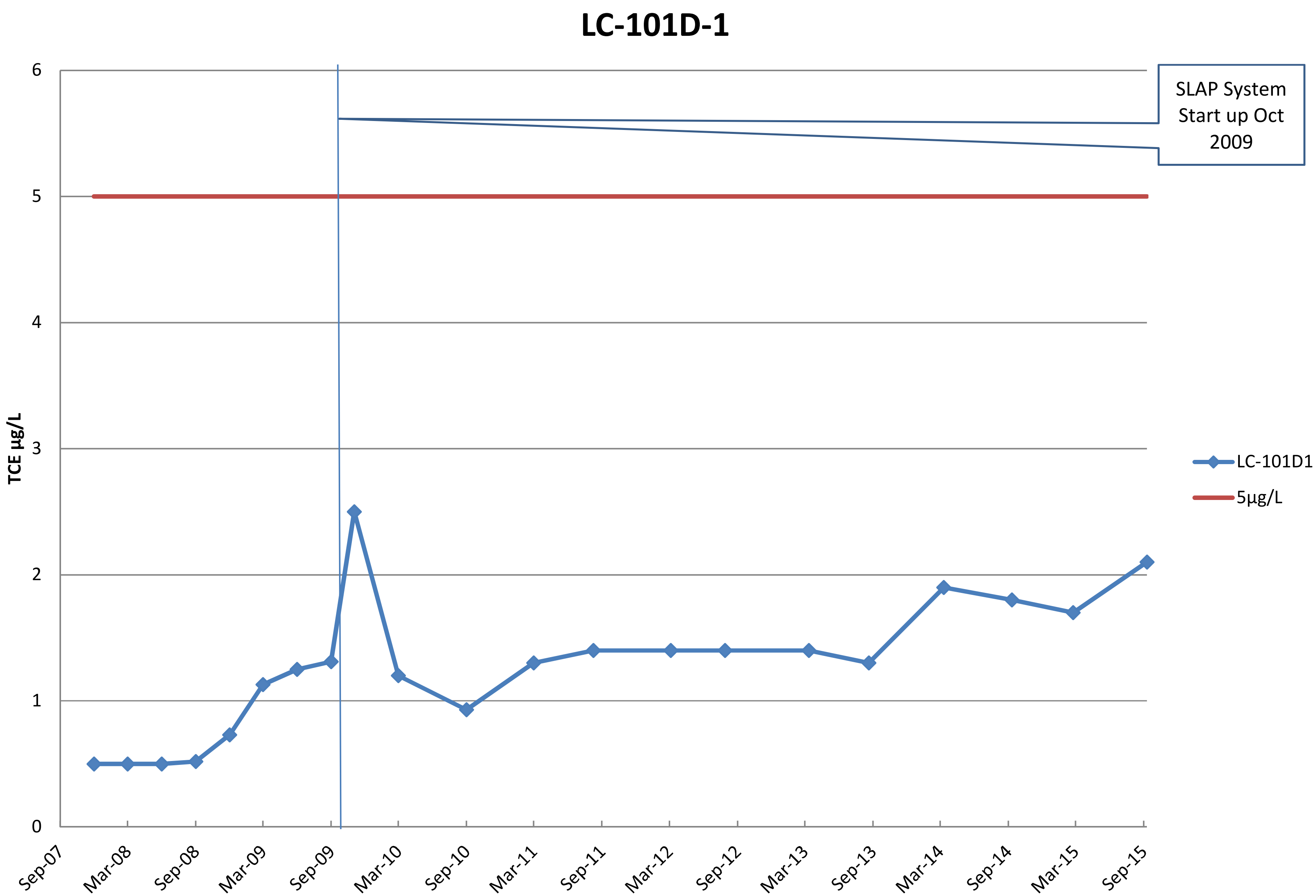
LC-98D-1

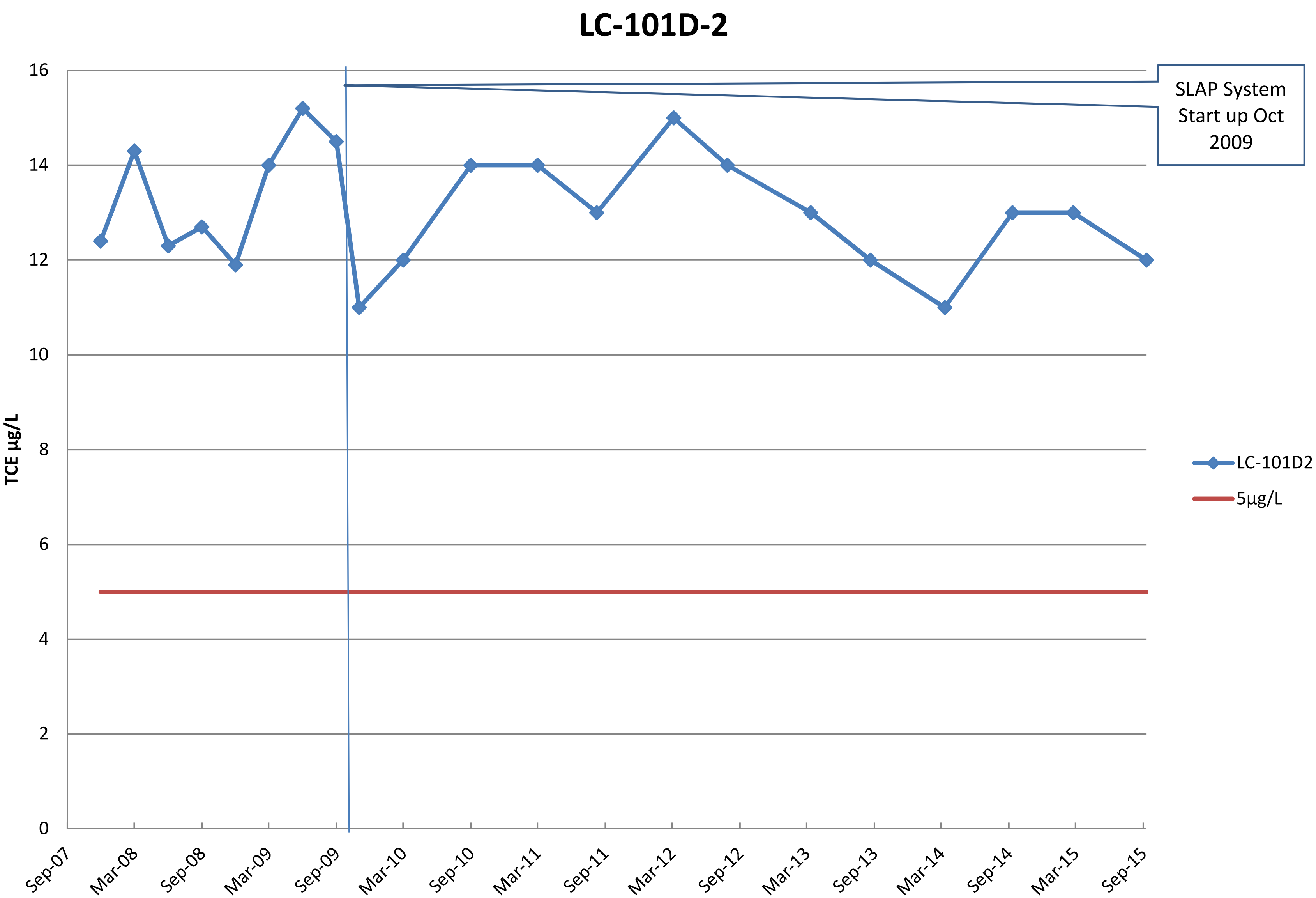

SLAP System Start up Oct 2009
TCE µg/L
45
40
35
30
25
20
15
10
5
0
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-98D1
5µg/L

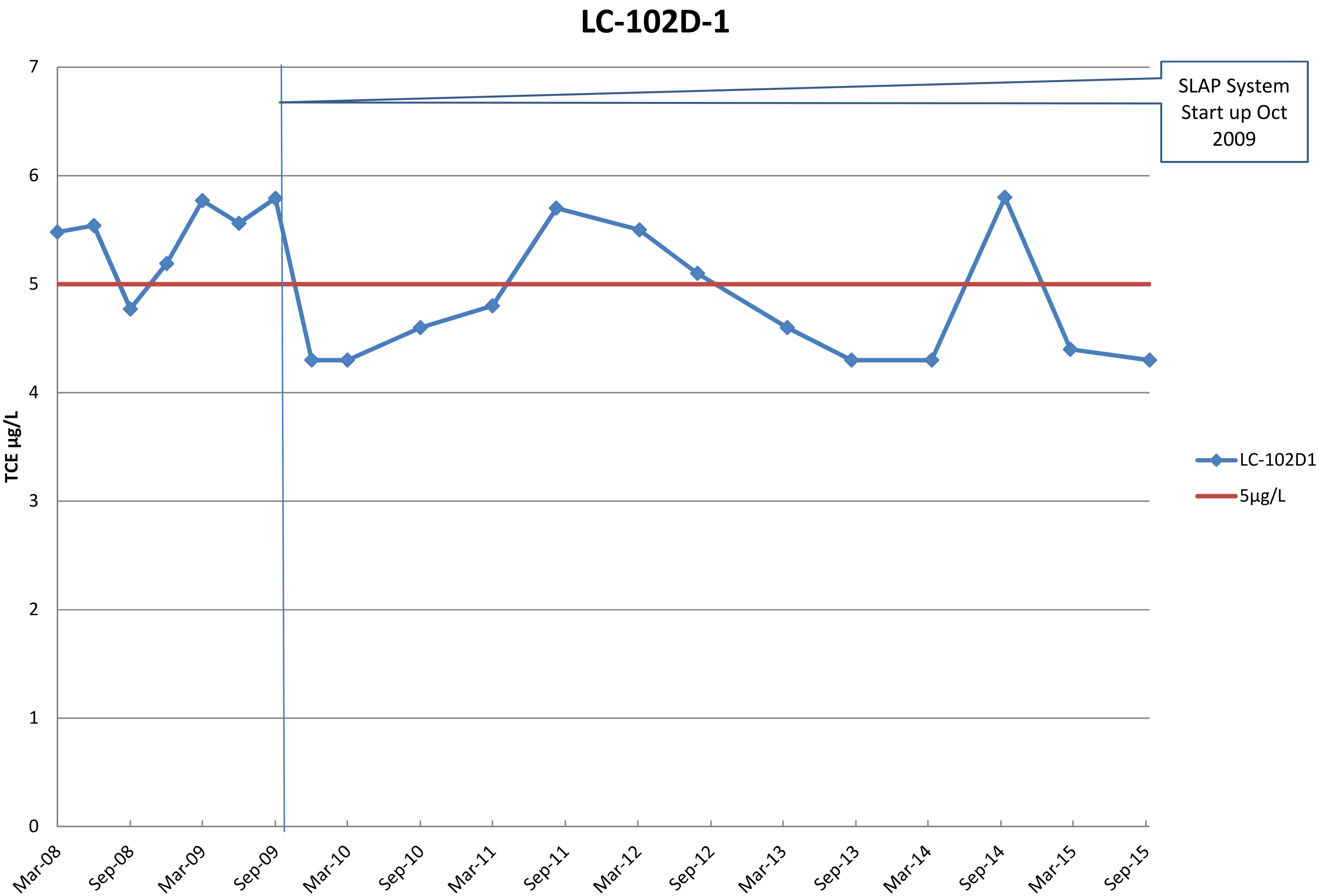
LC-98D-2


SLAP System Start up Oct 2009
TCE µg/L
40
35
30
25
20
15
10
5
0
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-98D2
5µg/L

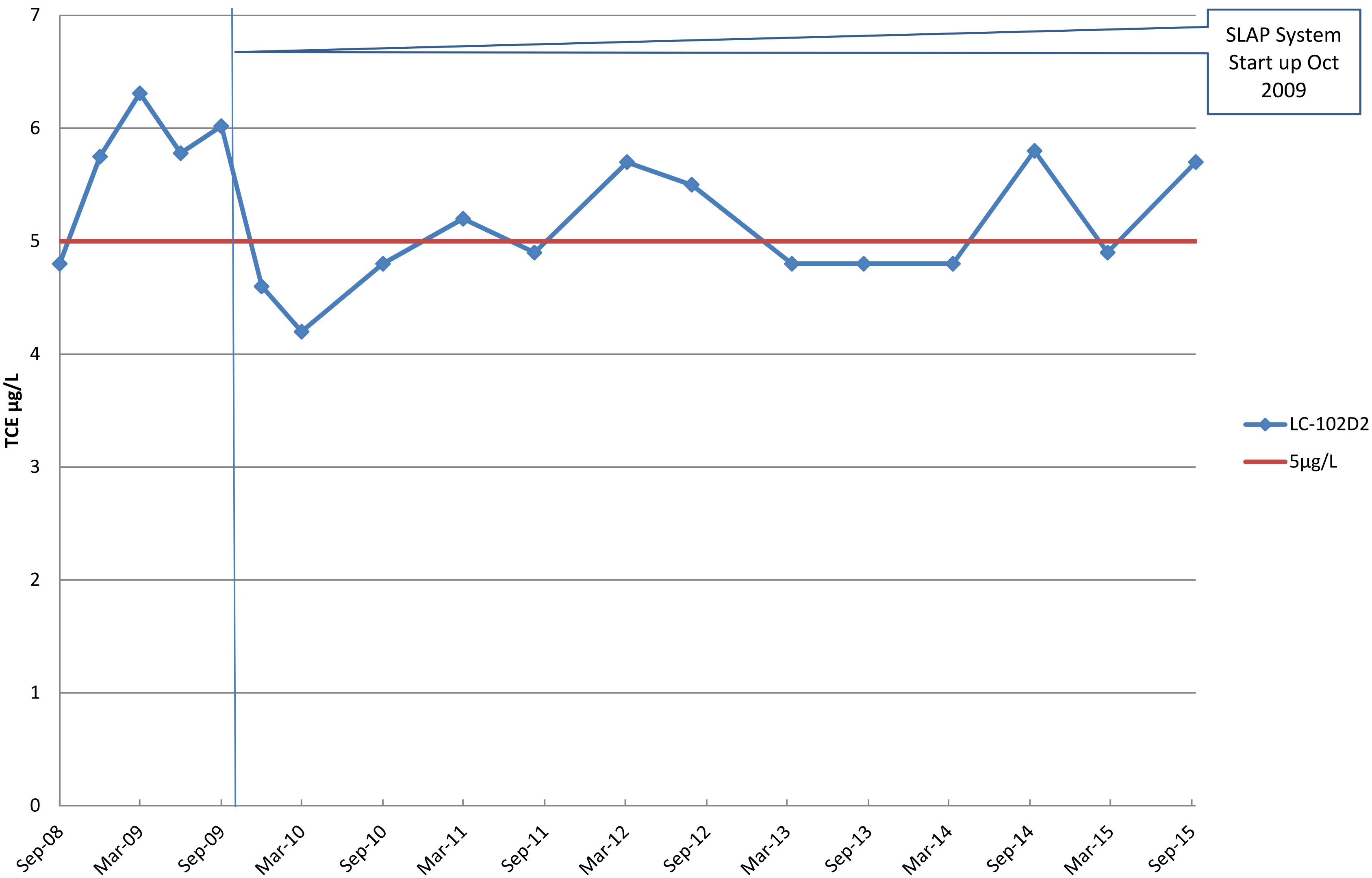

LC-99D
SLAP System Start up Oct 2009
TCE µg/L
120
100
80
60
40
20
0
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-99D
5µg/L

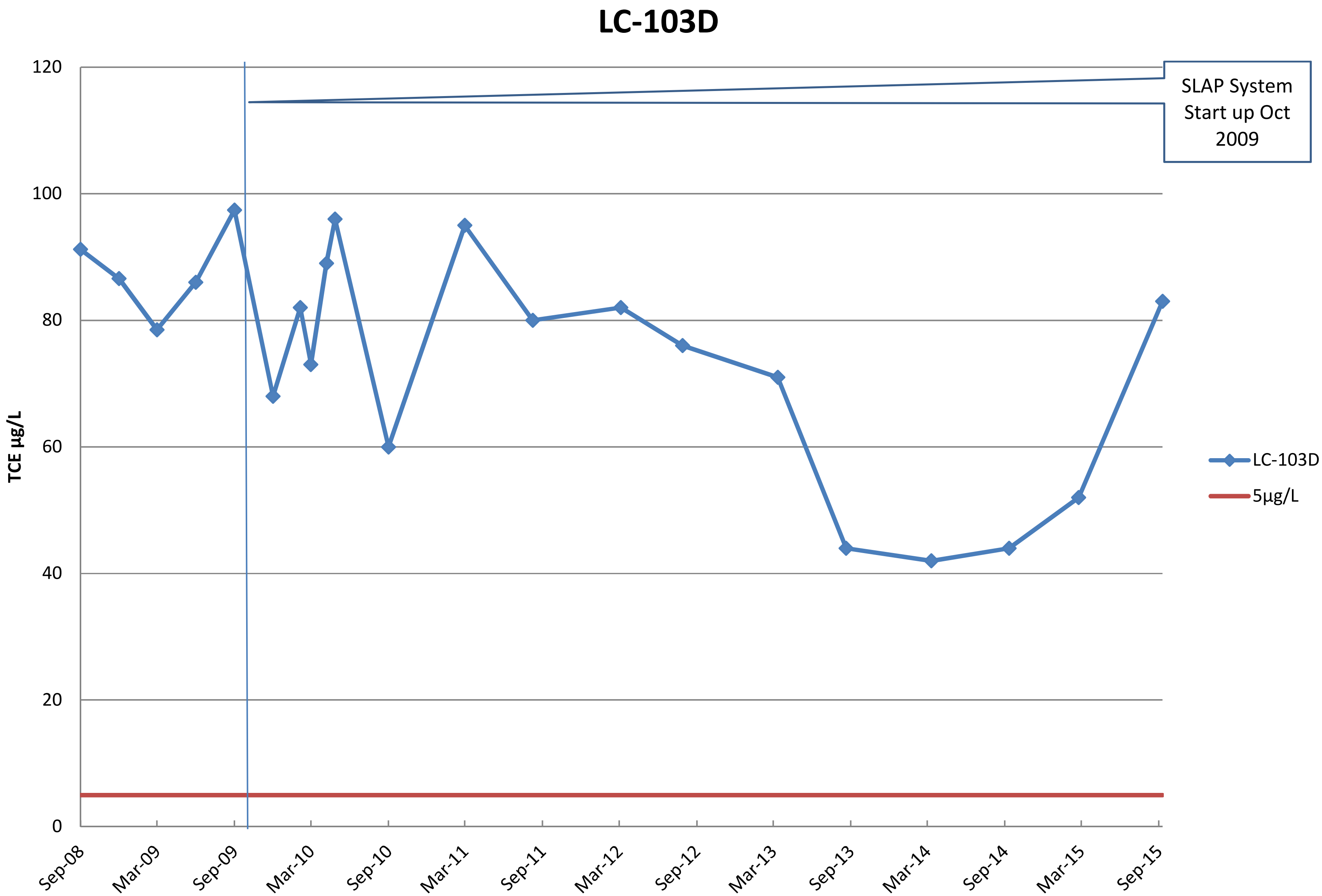

LC-101D-1
TCE µg/L
0
1
2
3
4
5
6
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
SLAP System Start up Oct 2009
LC-101D1
5µg/L

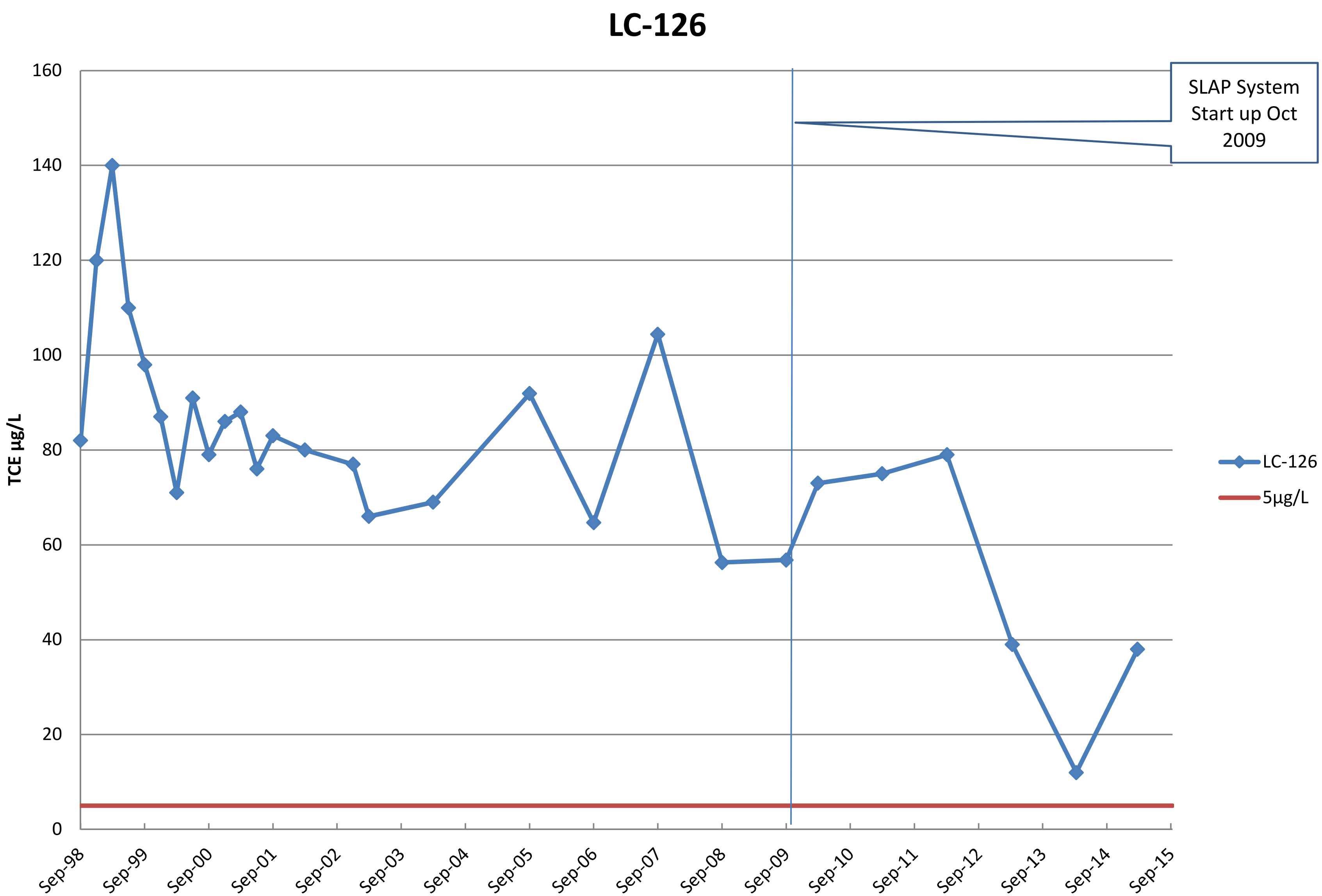

LC-101D-2
SLAP System Start up Oct 2009
TCE µg/L
0
2
4
6
8
10
12
14
16
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-101D2
5µg/L


LC-102D-1
SLAP System Start up Oct 2009
TCE µg/L
0
1
2
3
4
5
6
7
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-102D1
5µg/L

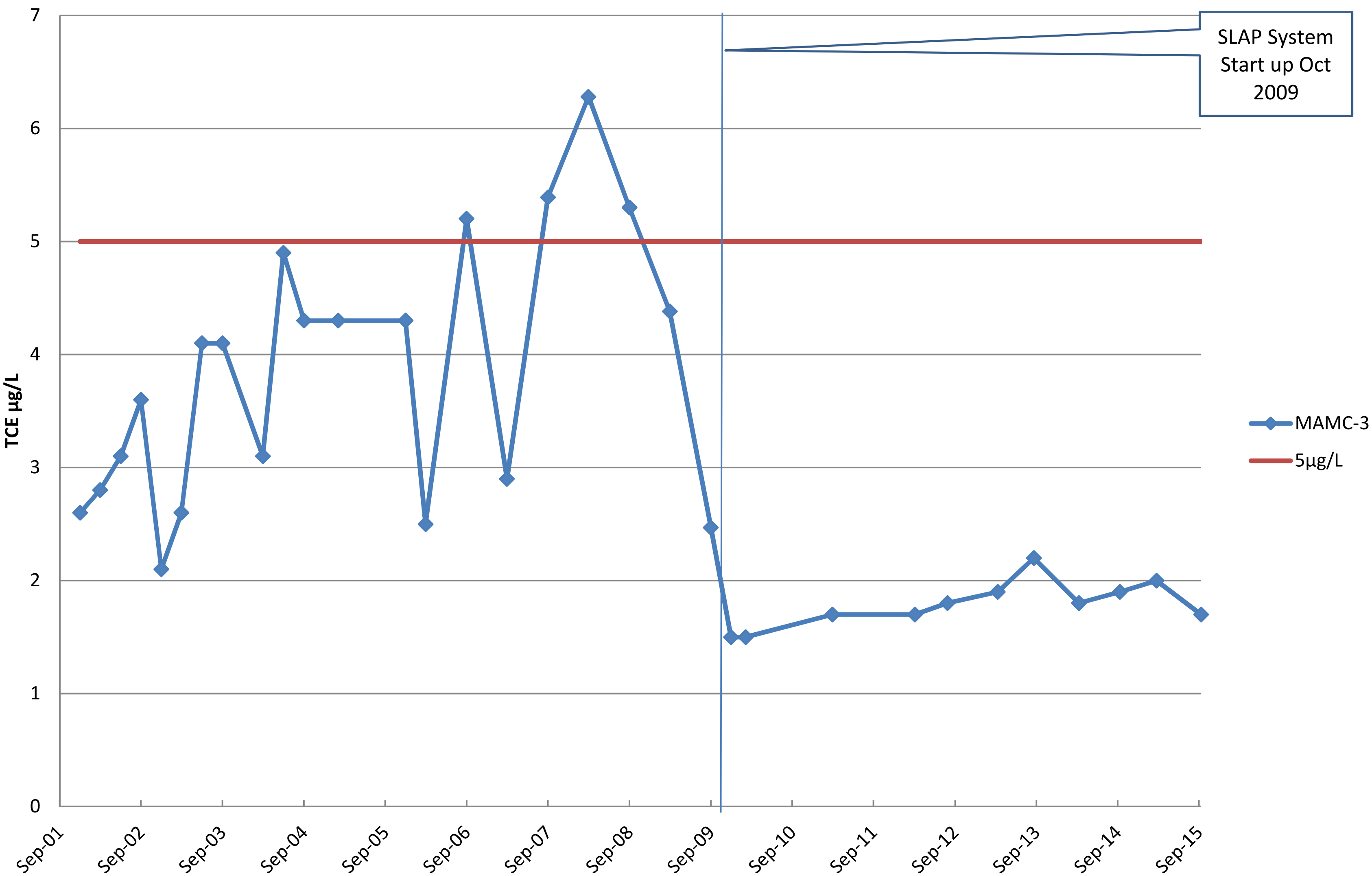
LC-102D-2

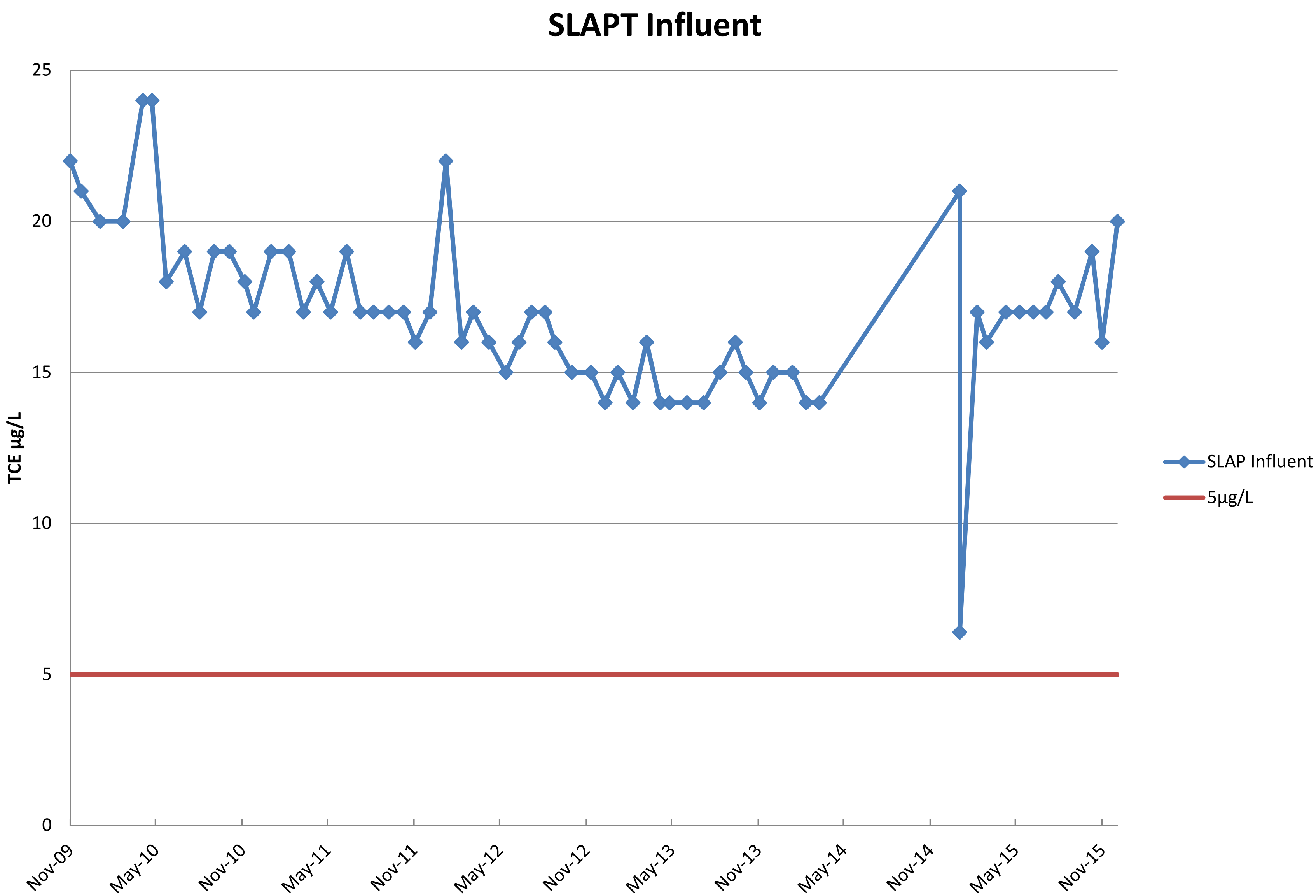

SLAP System Start up Oct 2009
TCE µg/L
0
1
2
3
4
5
6
7
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-102D2
5µg/L

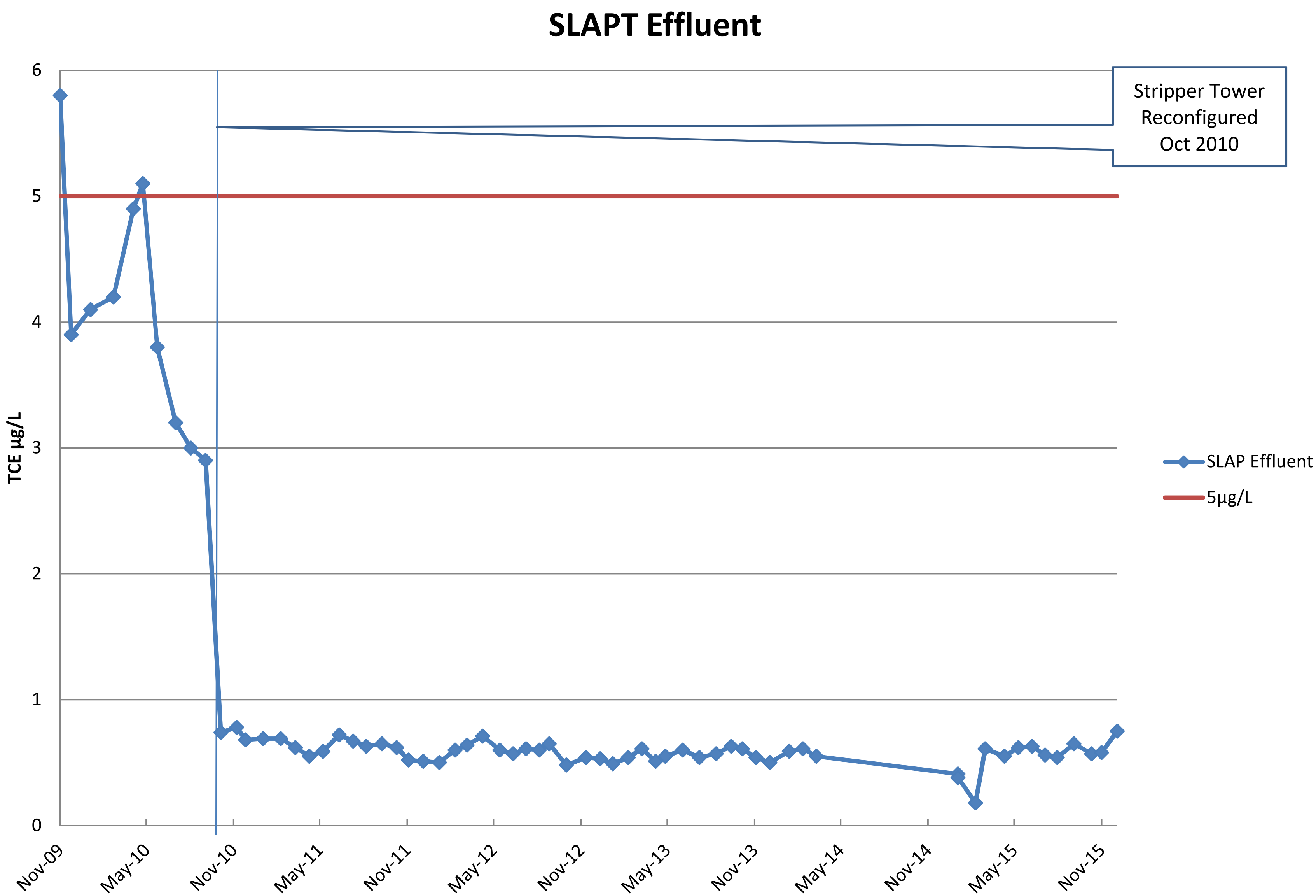

LC-103D
SLAP System Start up Oct 2009
TCE µg/L
120
100
80
60
40
20
0
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
LC-103D
5µg/L


LC-126
160
140
120
100
80
60
40
20
0
TCE µg/L
SLAP System Start up Oct 2009
LC-126
5µg/L
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15

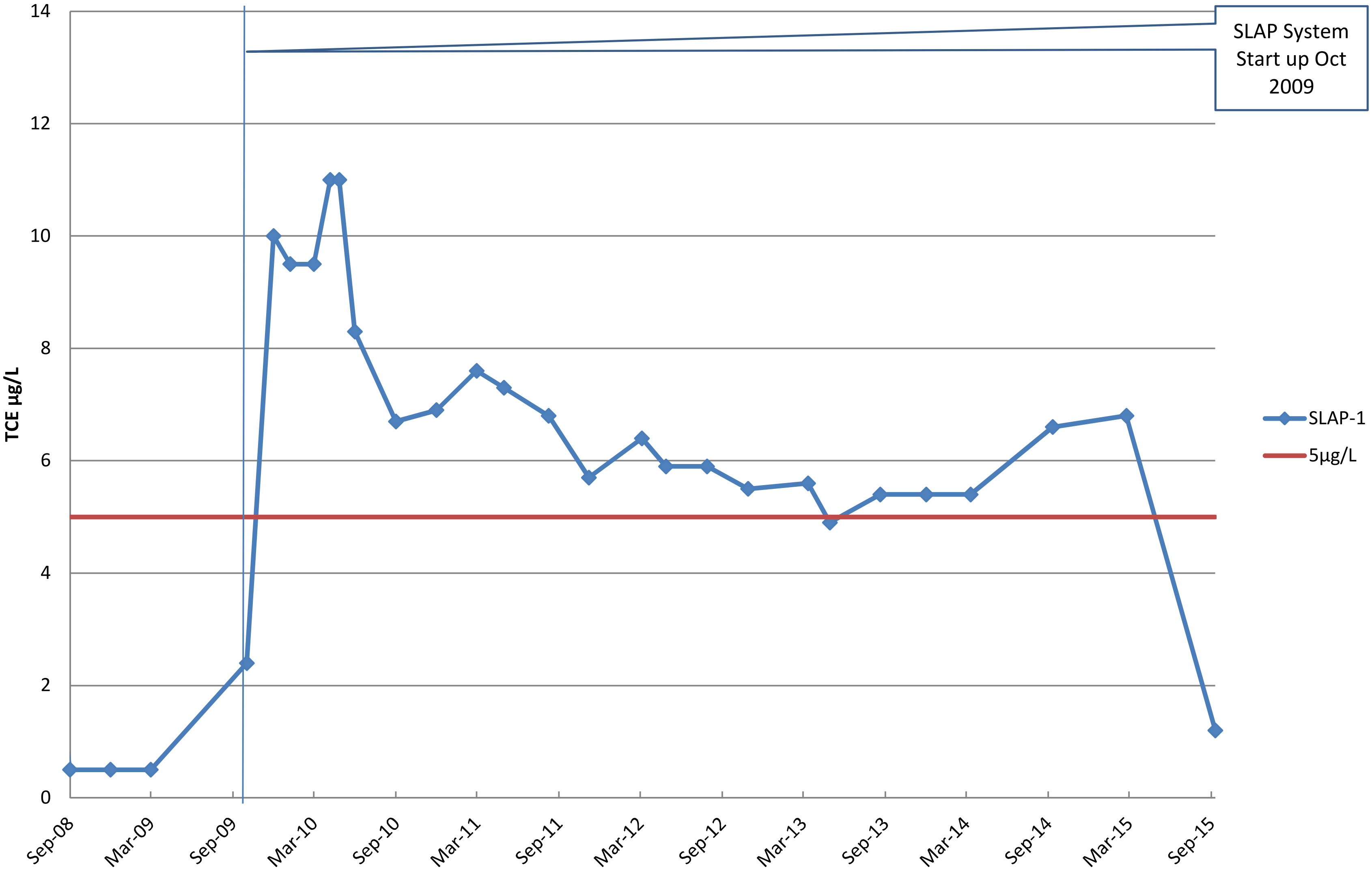
MAMC-3

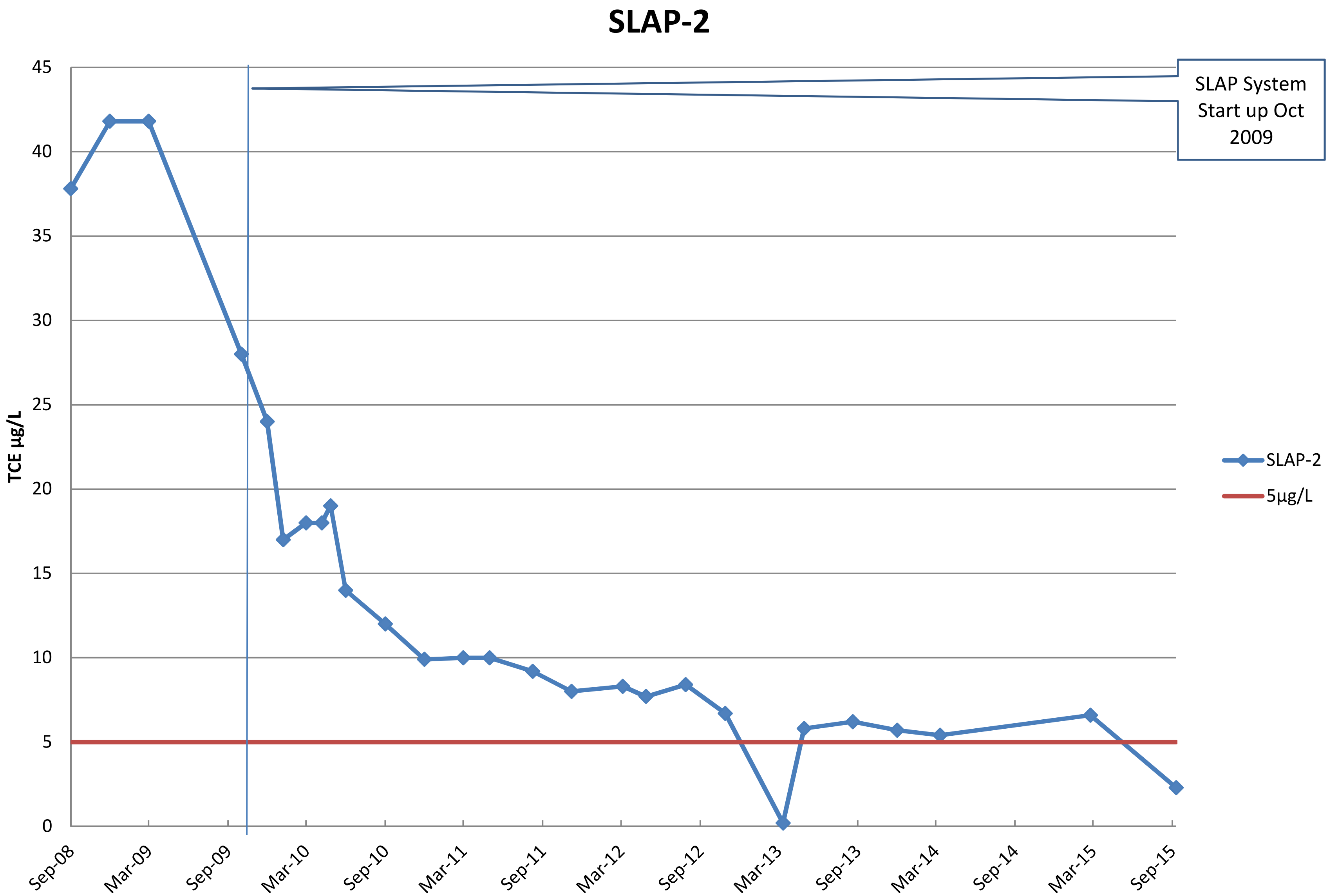

MAMC-3
7
6
5
4
3
2
1
0
TCE µg/L
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
SLAP System Start up Oct 2009
MAMC-3
5µg/L

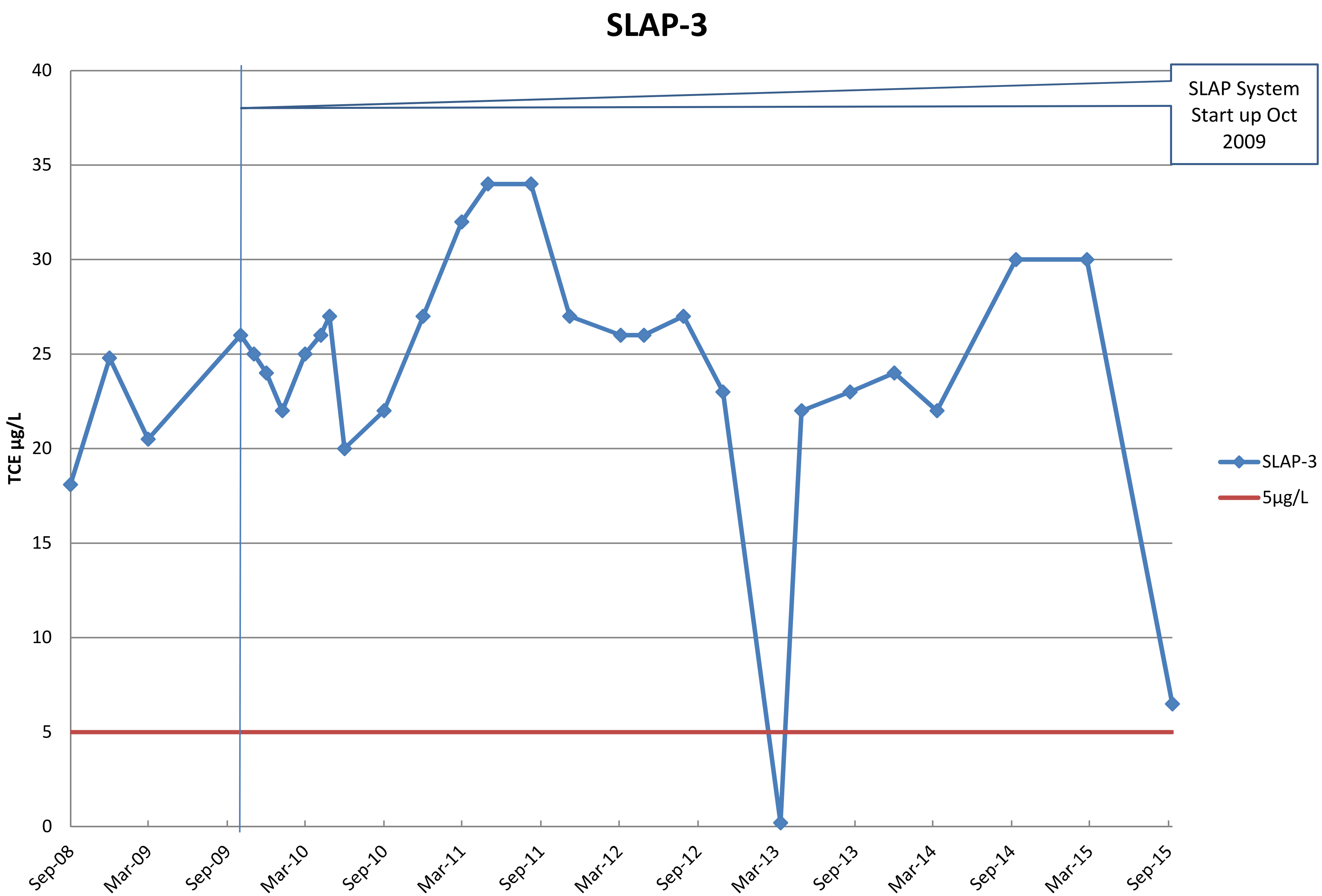

SLAPT Influent
TCE µg/L
25
20
15
10
5
0
Nov-09
May-10
Nov-10
May-11
Nov-11
May-12
Nov-12
May-13
Nov-13
May-14
Nov-14
May-15
Nov-15
SLAP Influent
5µg/L

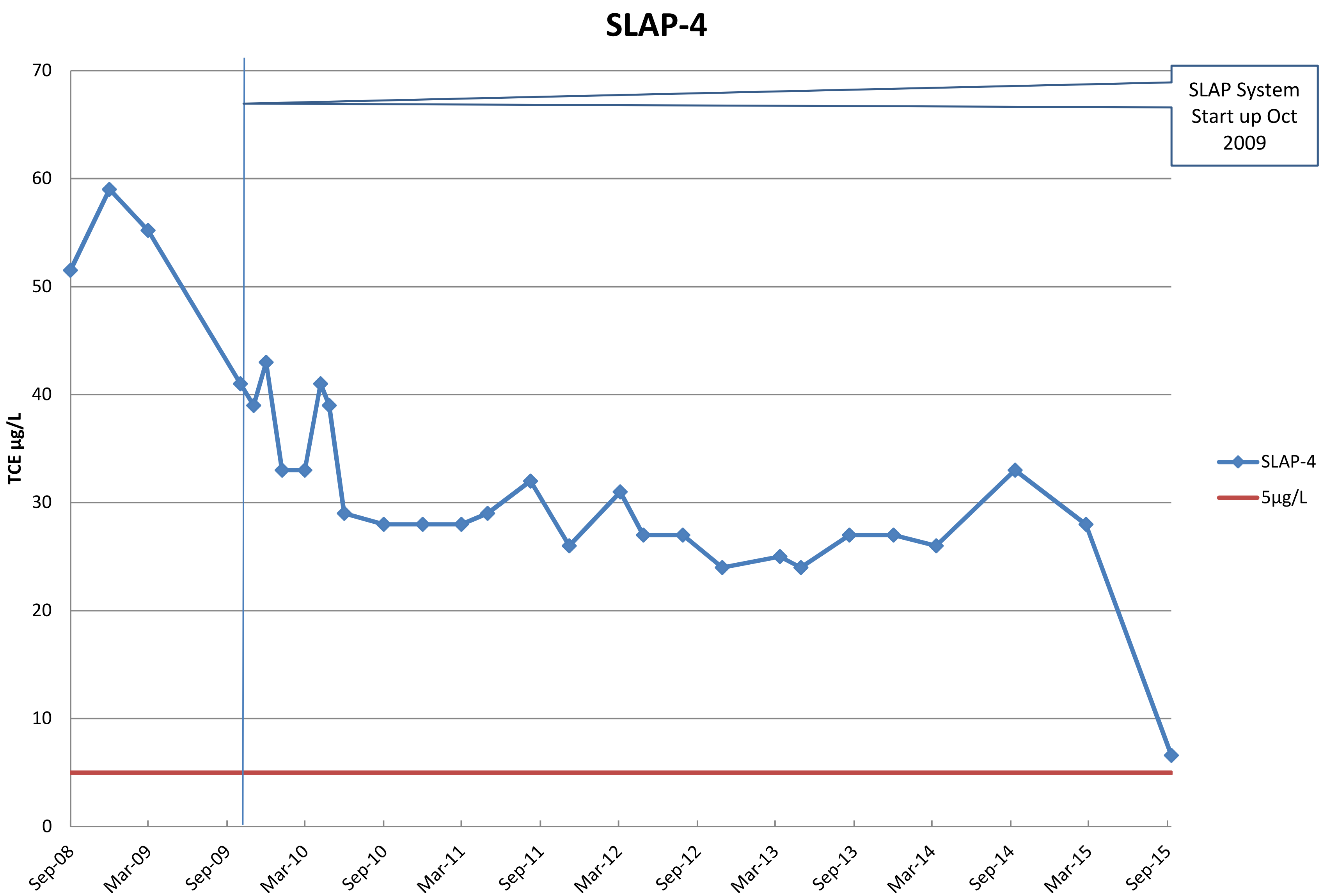

SLAPT Effluent
6
5
4
3
2
1
0
TCE µg/L
Stripper Tower Reconfigured Oct 2010
SLAP Effluent
5µg/L
Nov-09
May-10
Nov-10
May-11
Nov-11
May-12
Nov-12
May-13
Nov-13
May-14
Nov-14
May-15
Nov-15

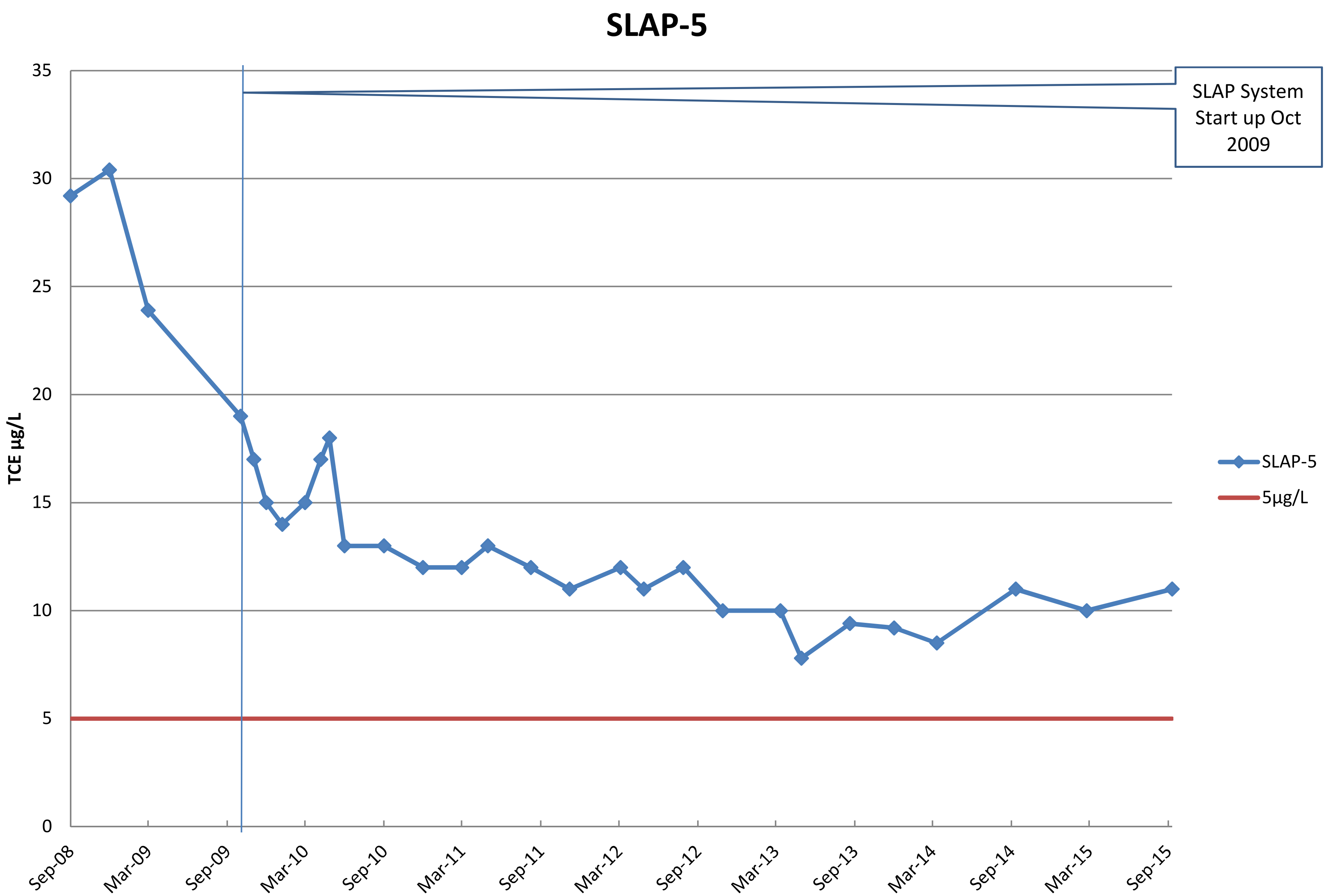
SLAP-1

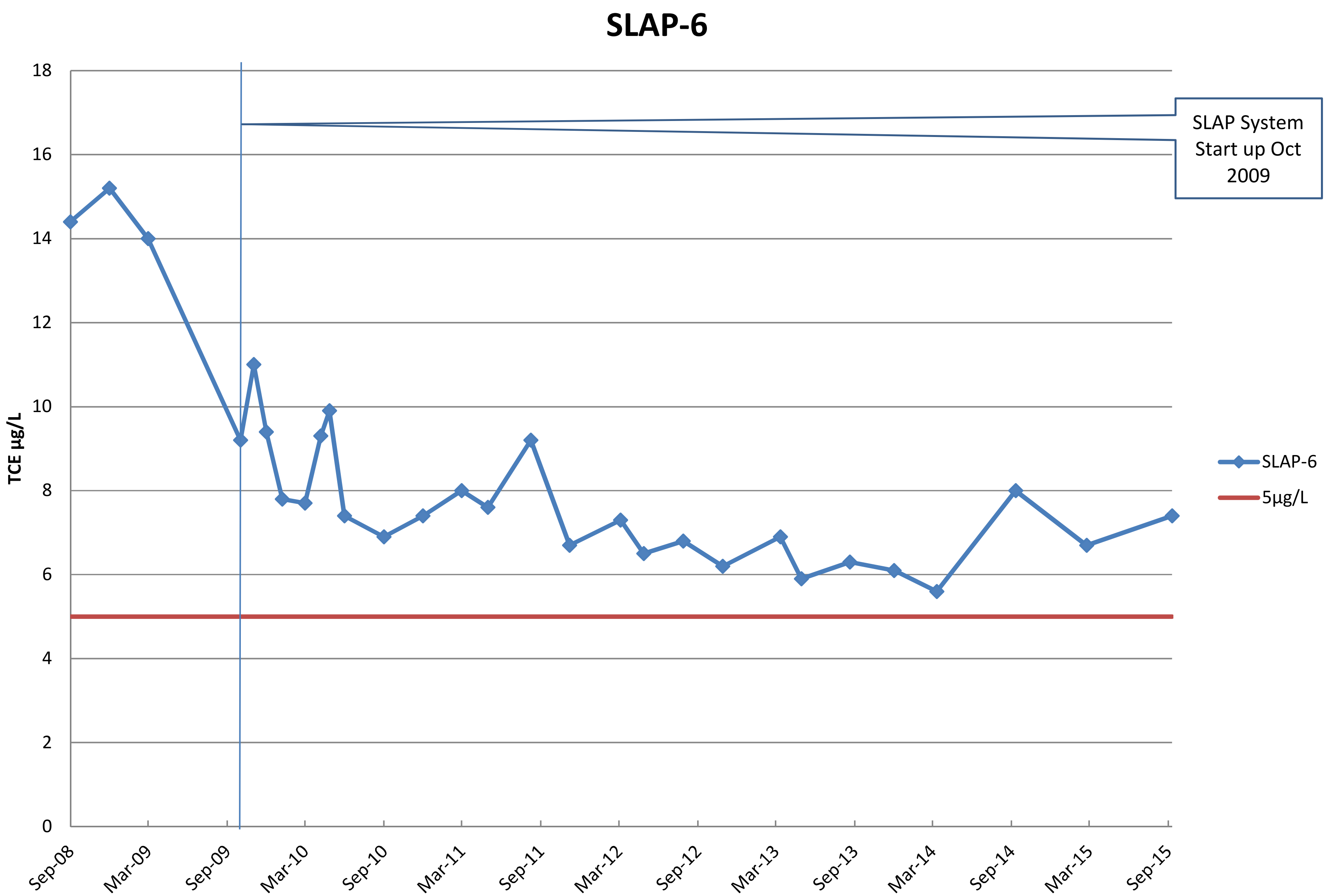

SLAP System Start up Oct 2009
TCE µg/L
14
12
10
8
6
4
2
0
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
SLAP-1
5µg/L

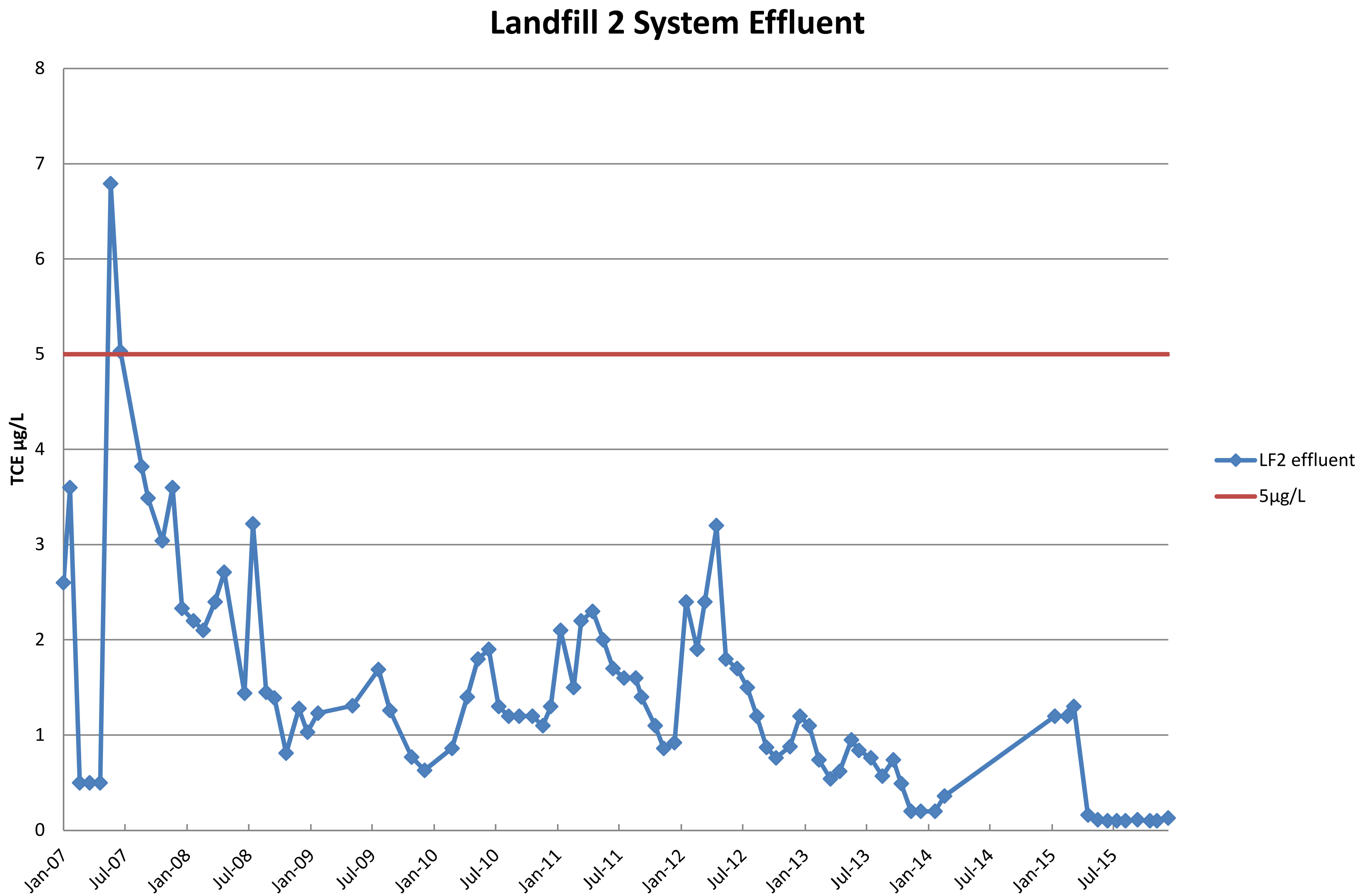

SLAP-2
SLAP System Start up Oct 2009
TCE µg/L
45
40
35
30
25
20
15
10
5
0
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
SLAP-2
5µg/L

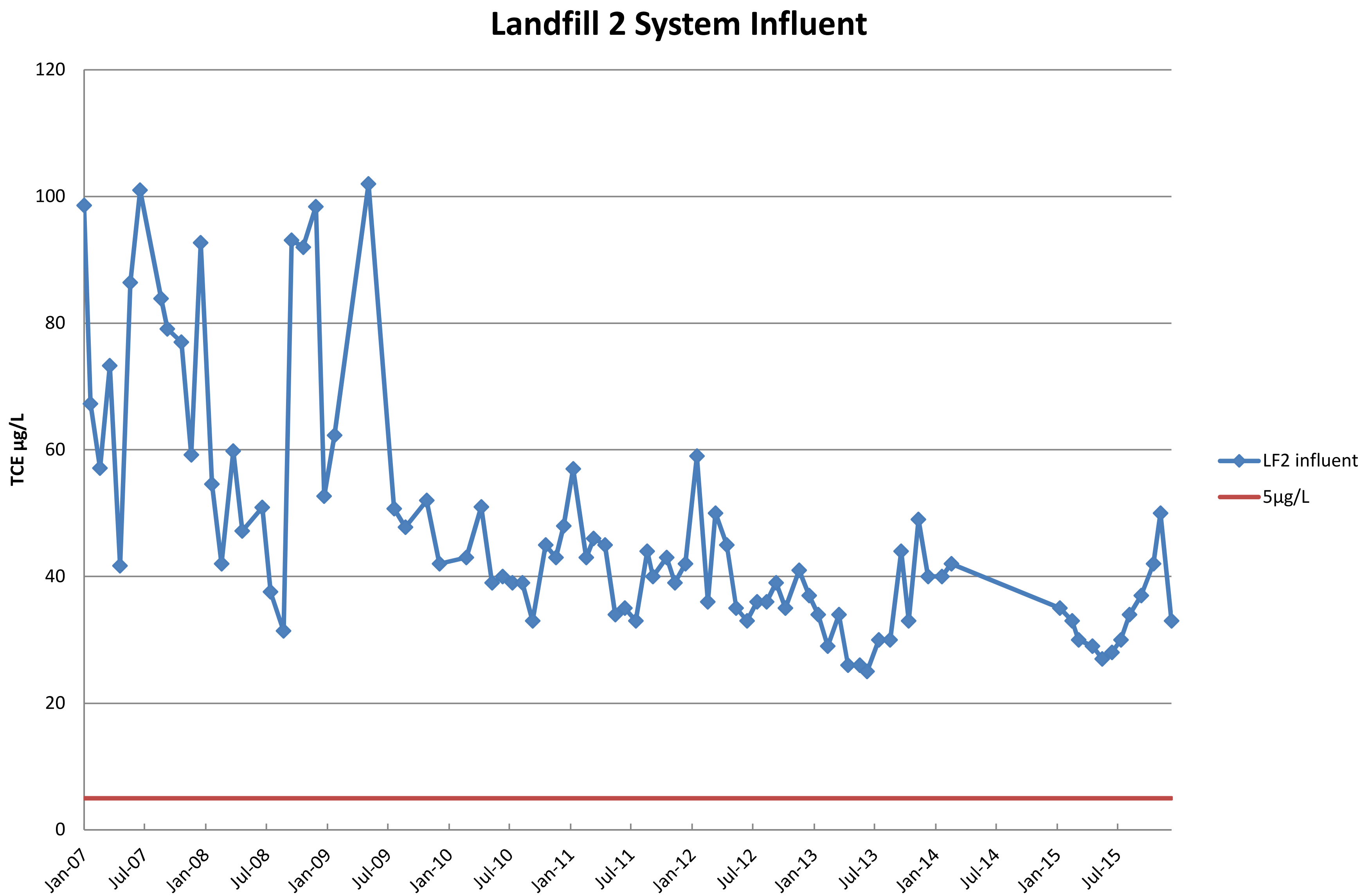

SLAP-3
40
35
30
25
20
15
10
5
0
TCE µg/L
SLAP System Start up Oct 2009
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
SLAP-3
5µg/L

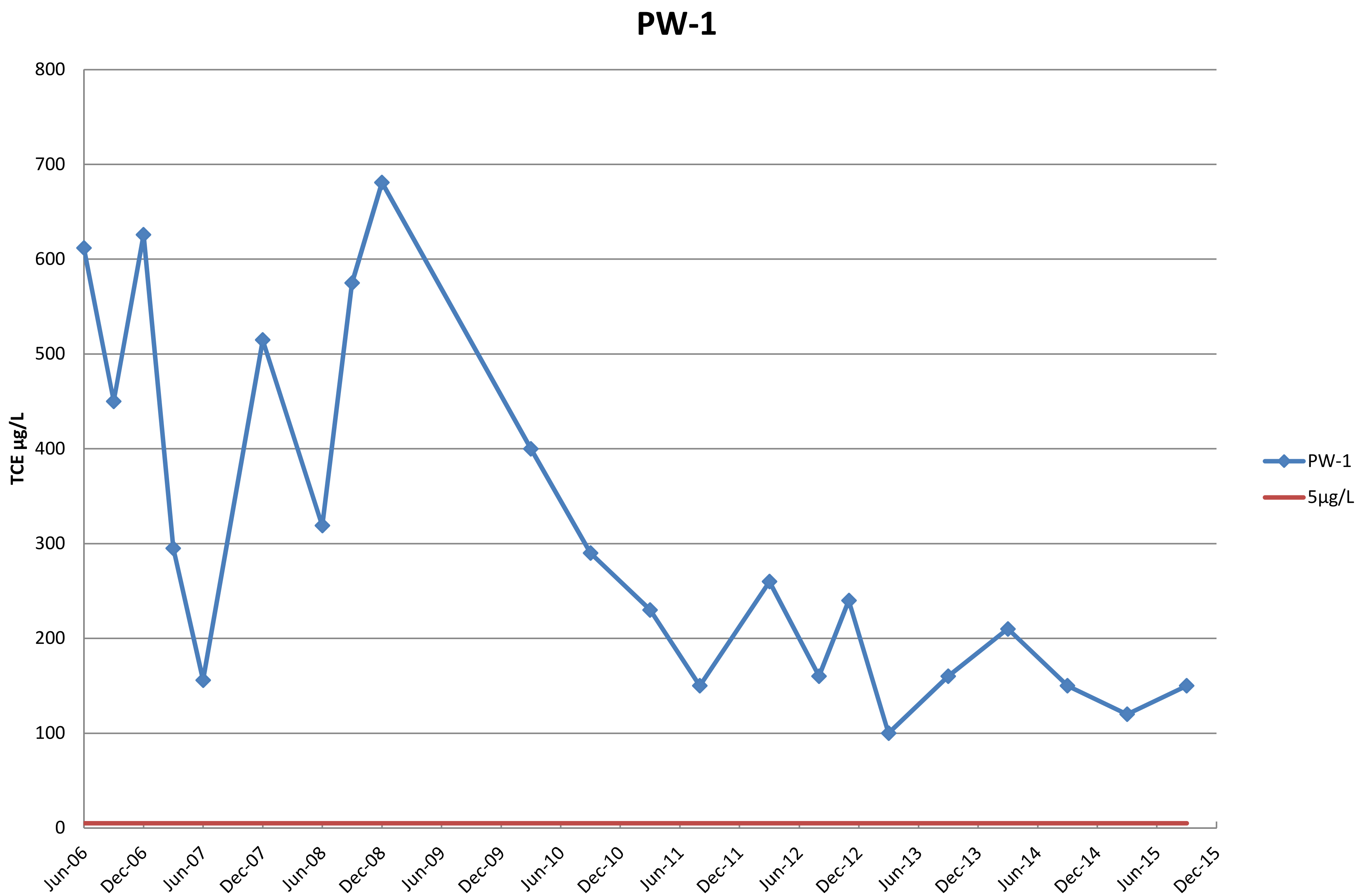

SLAP-4
SLAP System Start up Oct 2009
TCE µg/L
70
60
50
40
30
20
10
0
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
SLAP-4
5µg/L

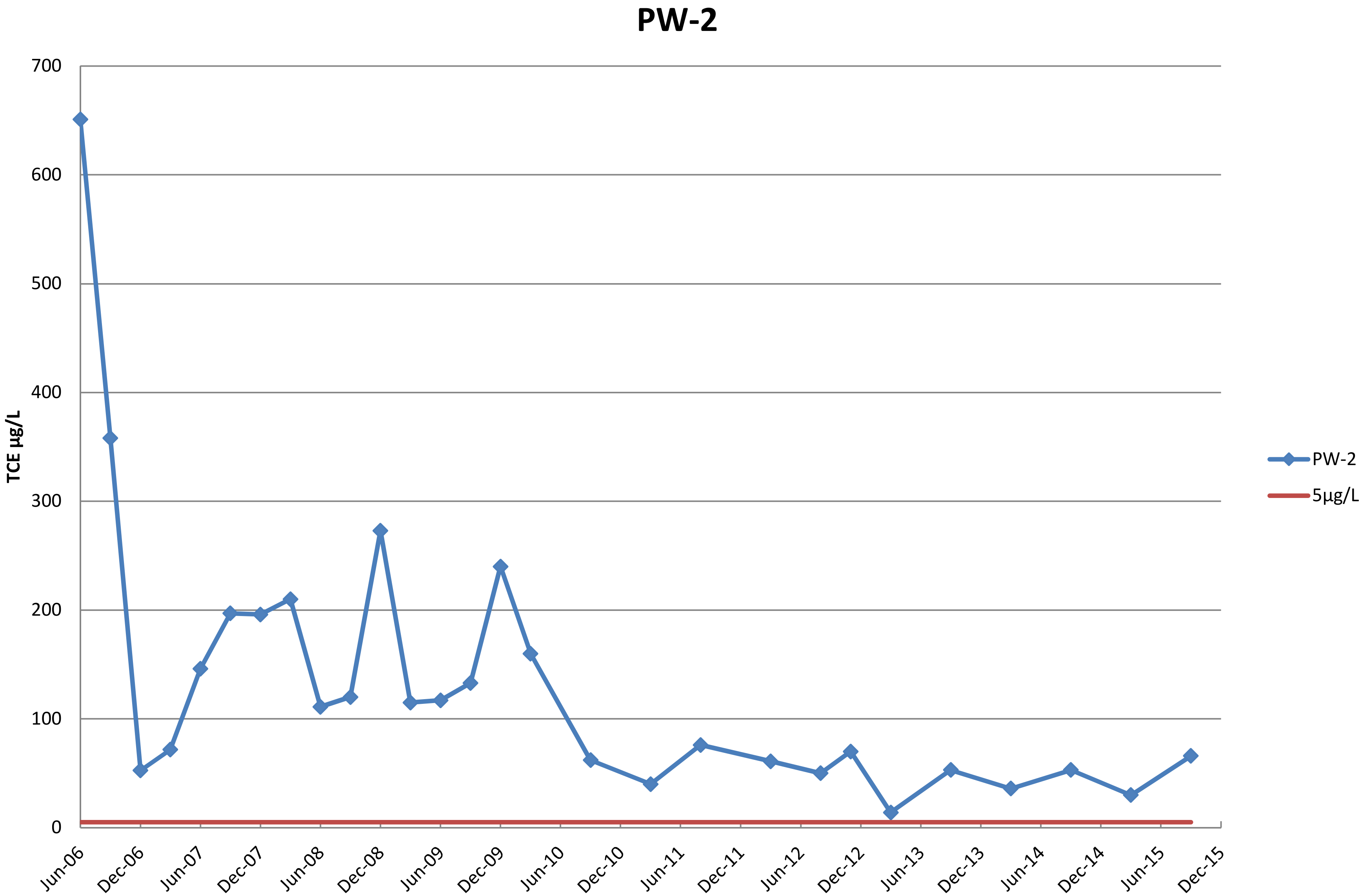

SLAP-5
TCE µg/L
35
30
25
20
15
10
5
0
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
SLAP System Start up Oct 2009
SLAP-5
5µg/L


SLAP-6
18
16
14
12
10
8
6
4
2
0
TCE µg/L
SLAP System Start up Oct 2009
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
SLAP-6
5µg/L

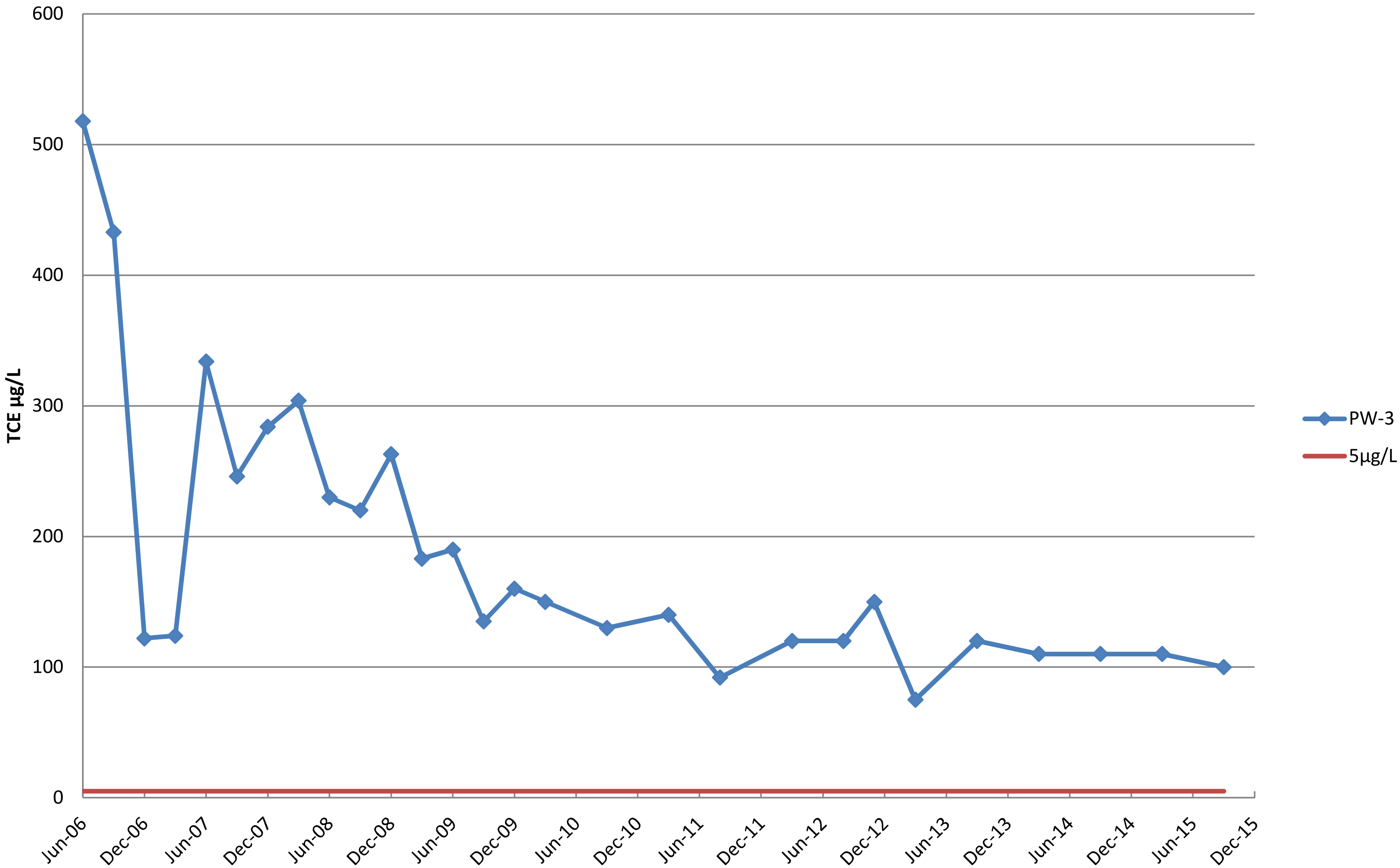

Landfill 2 System Effluent
TCE µg/L
8
7
6
5
4
3
2
1
0
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
LF2 effluent
5µg/L

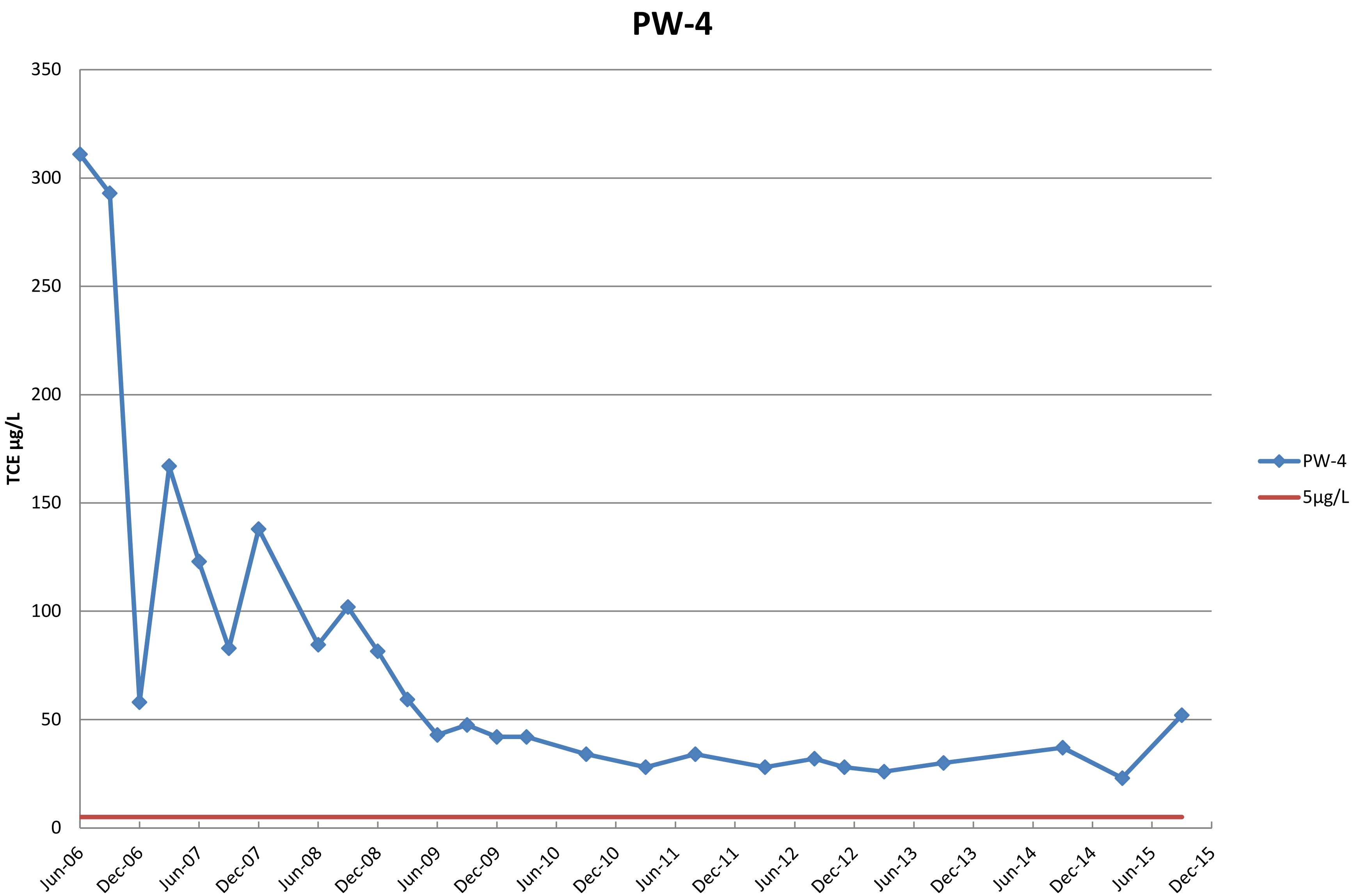

Landfill 2 System Influent
TCE µg/L
120
100
80
60
40
20
0
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
LF2 influent
5µg/L

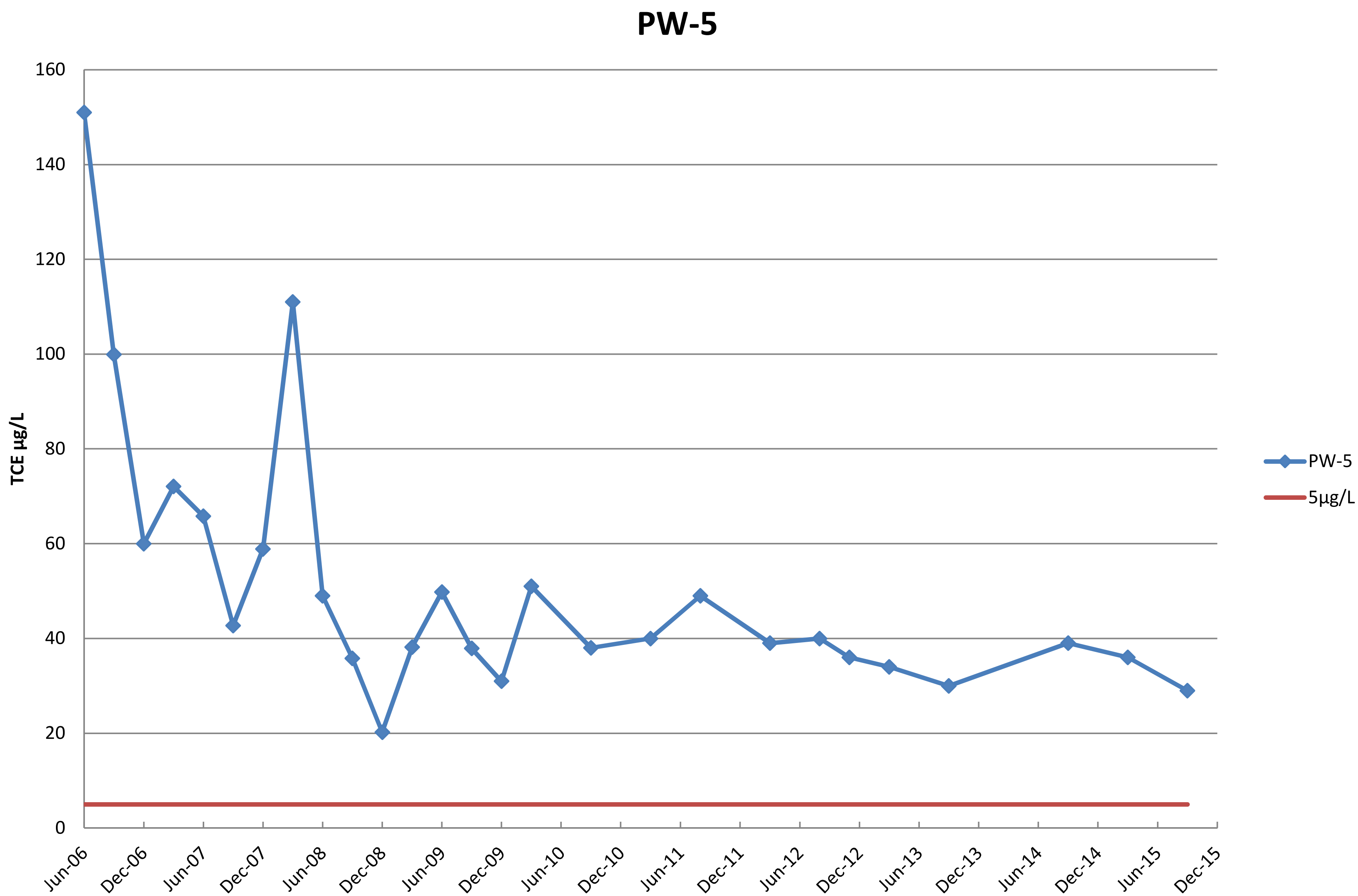

PW-1
TCE µg/L
800
700
600
500
400
300
200
100
0
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
PW-1
5µg/L


PW-2
TCE µg/L
700
600
500
400
300
200
100
0
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
PW-2
5µg/L

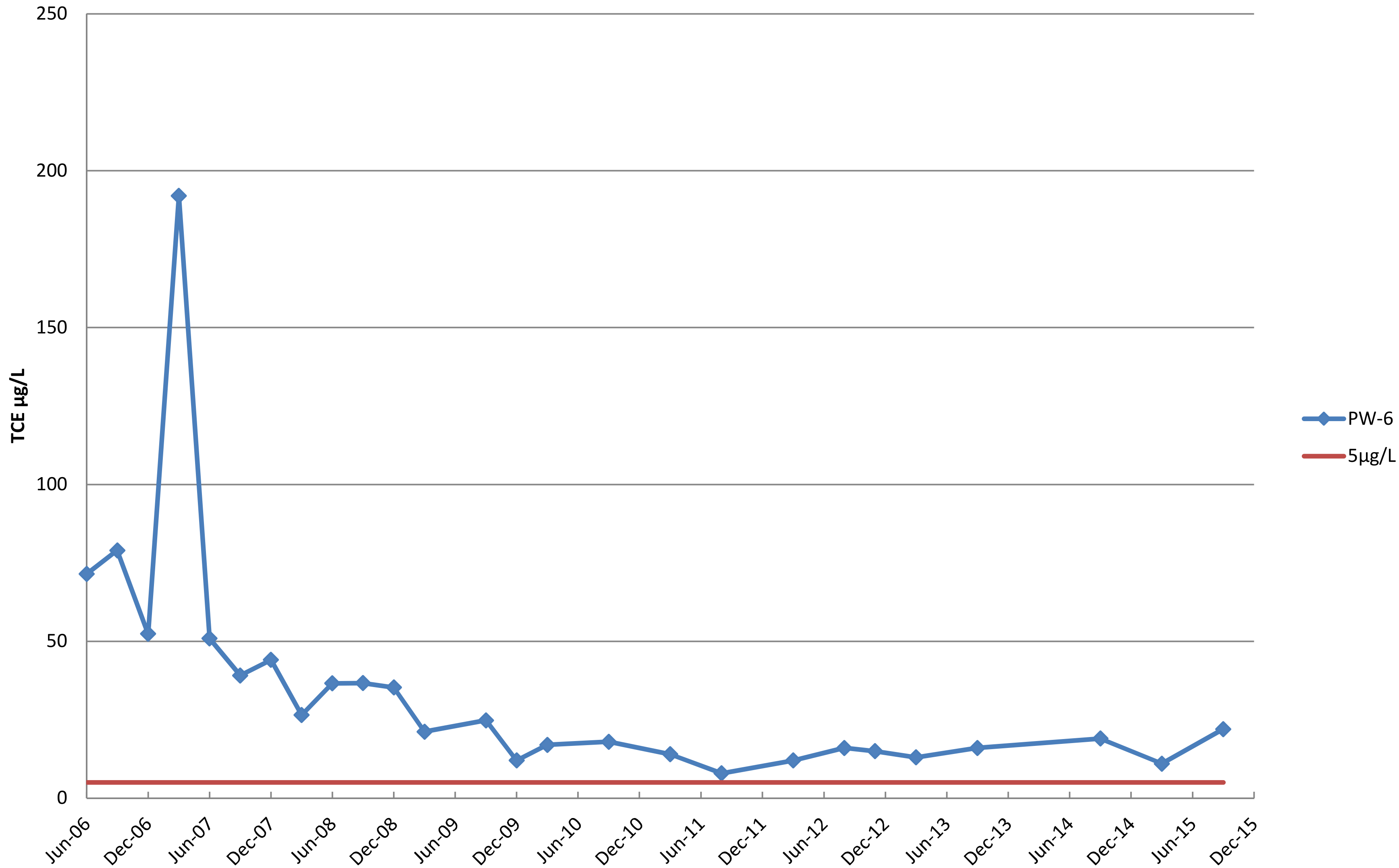
PW-3

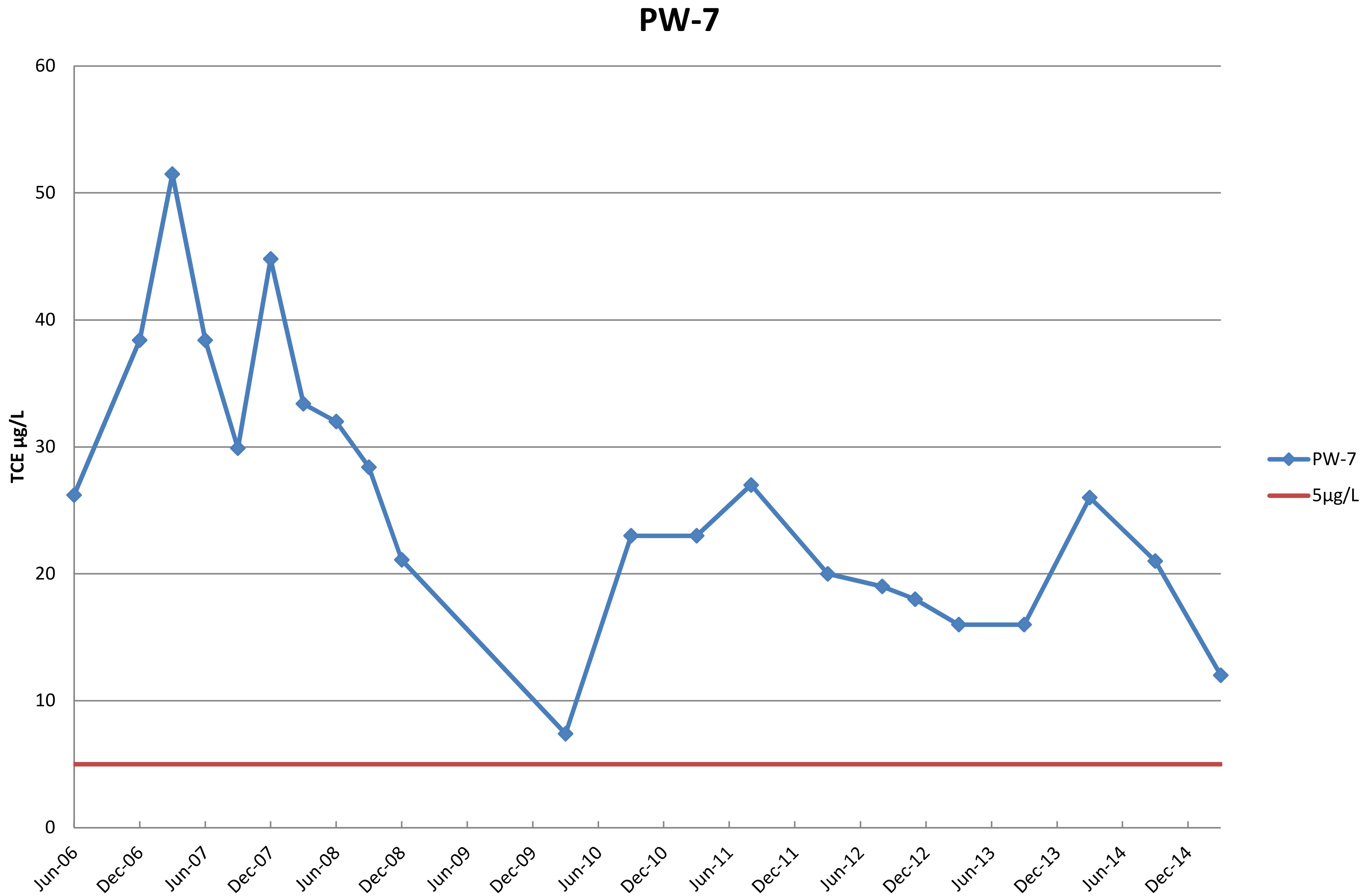

TCE µg/L
600
500
400
300
200
100
0
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
PW-3
5µg/L

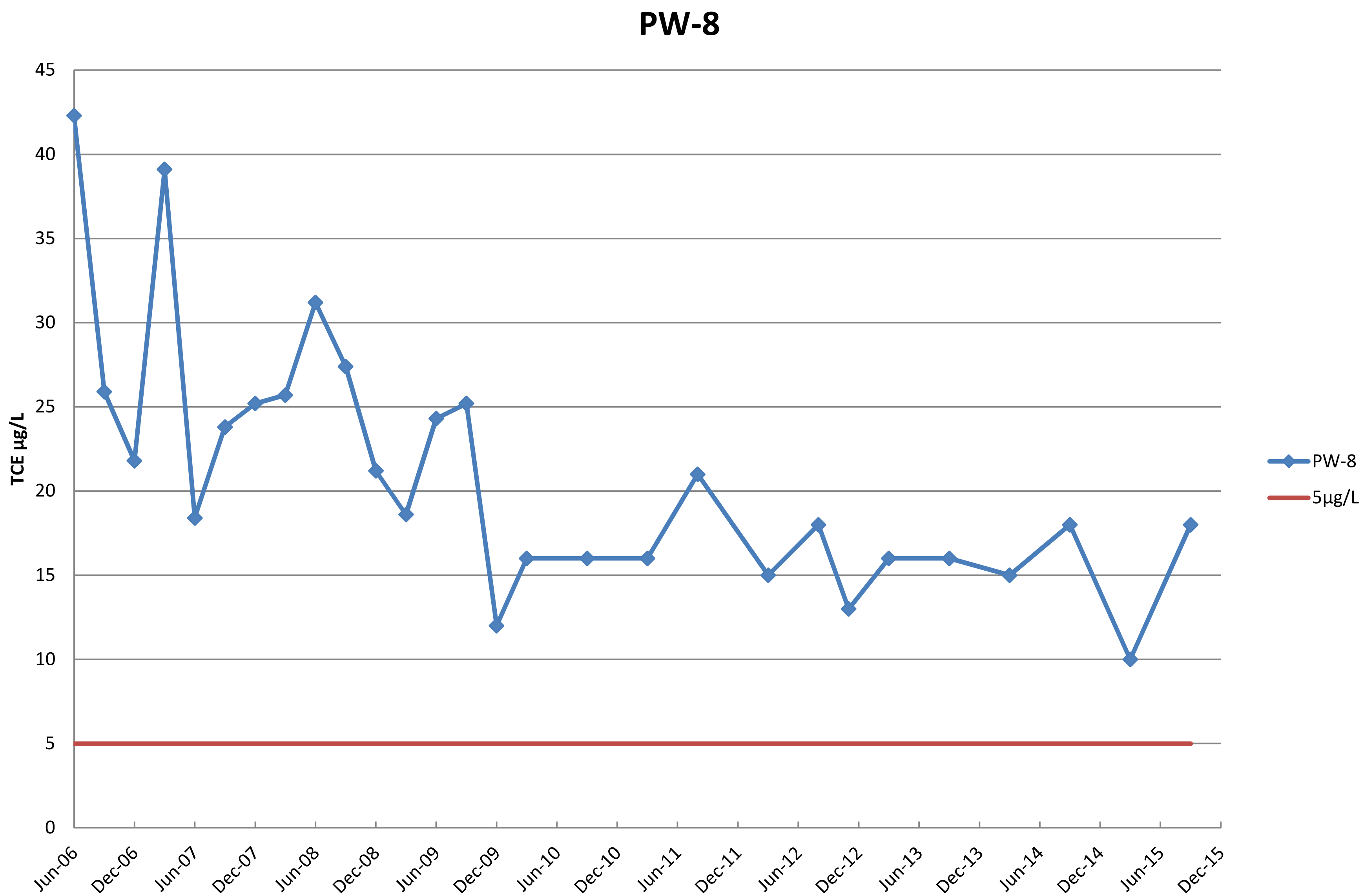

PW-4
TCE µg/L
350
300
250
200
150
100
50
0
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
PW-4
5µg/L

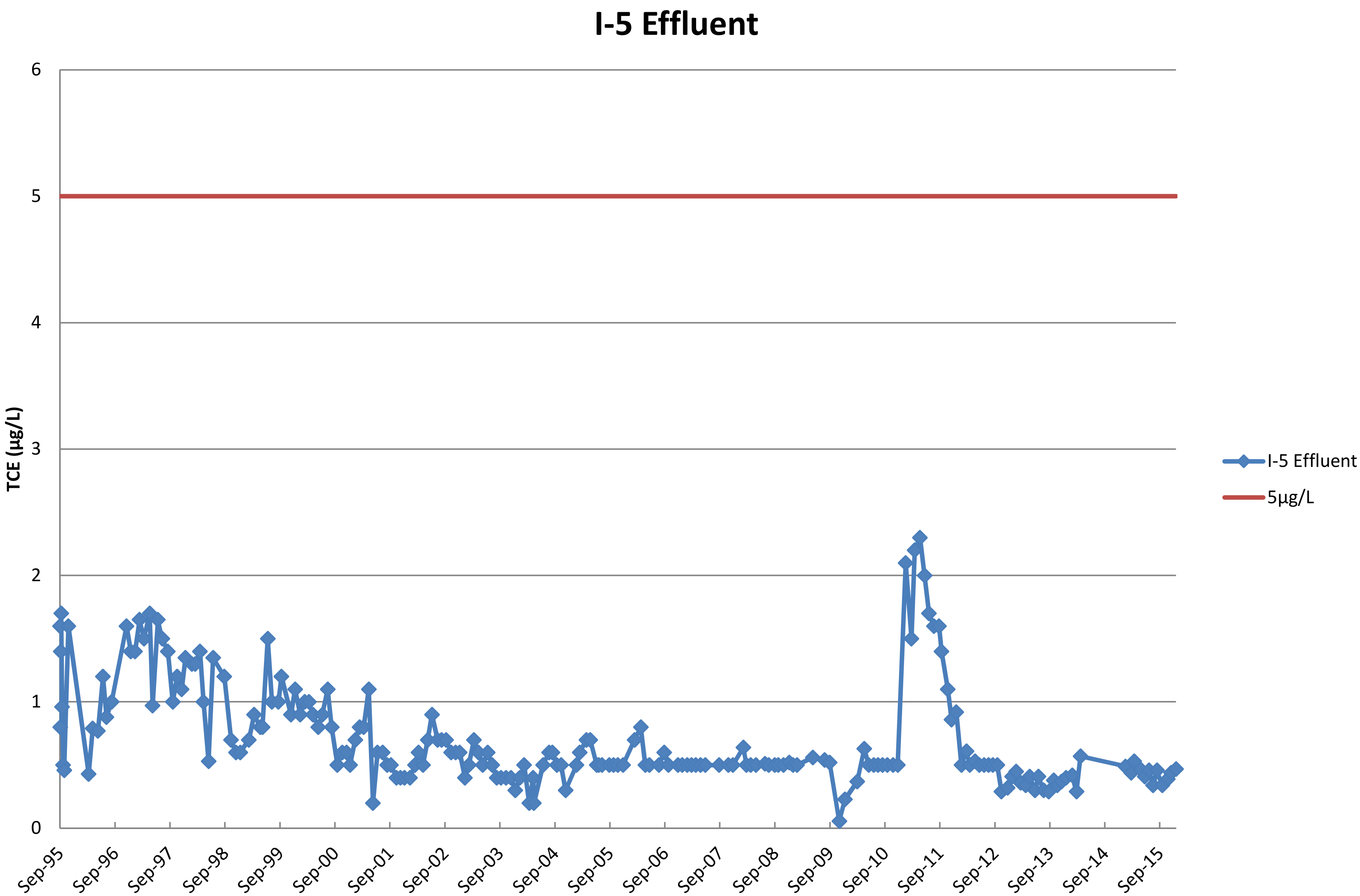

PW-5
TCE µg/L
160
140
120
100
80
60
40
20
0
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
PW-5
5µg/L

PW-6

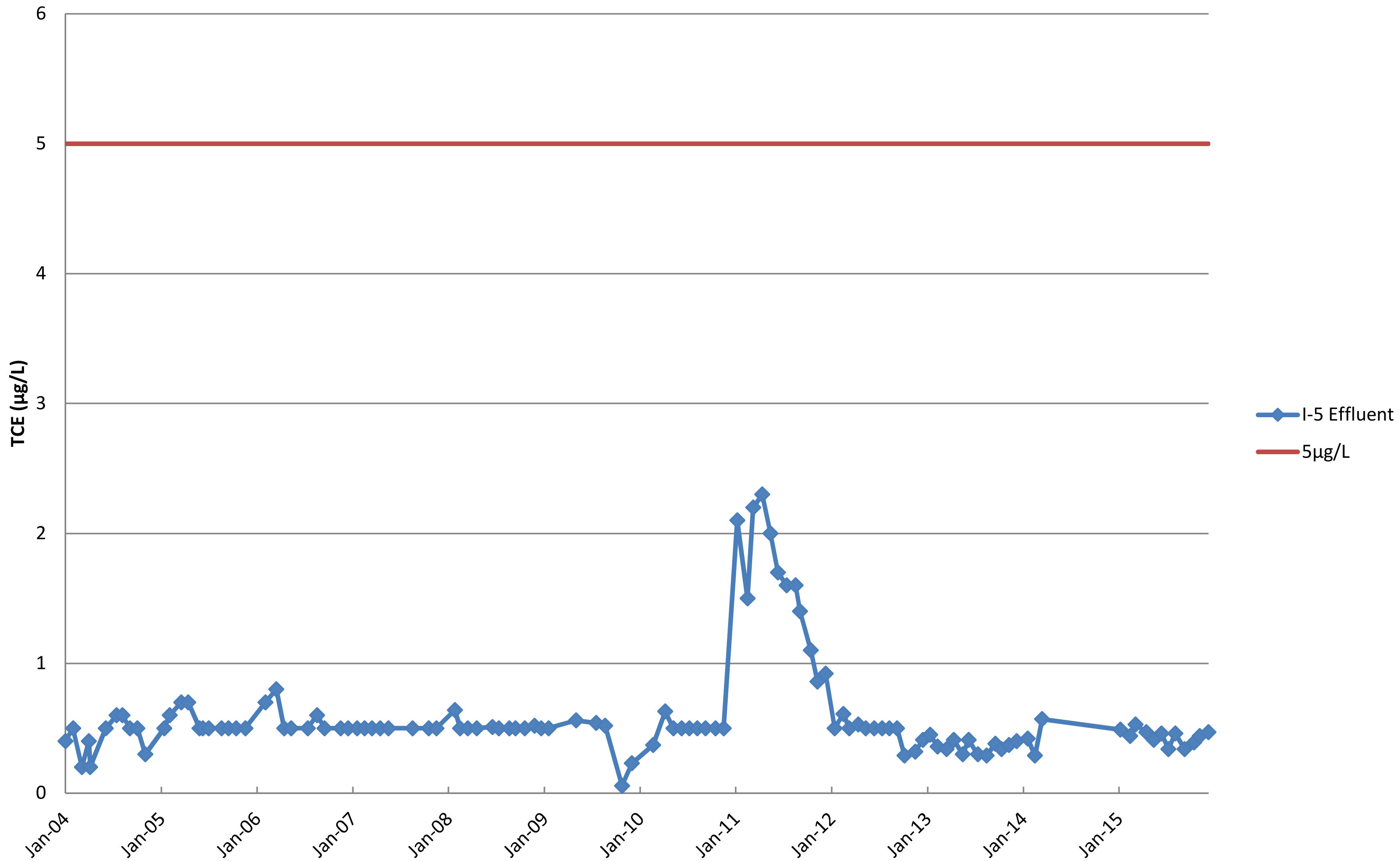

250
200
150
100
50
0
TCE µg/L
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
PW-6
5µg/L

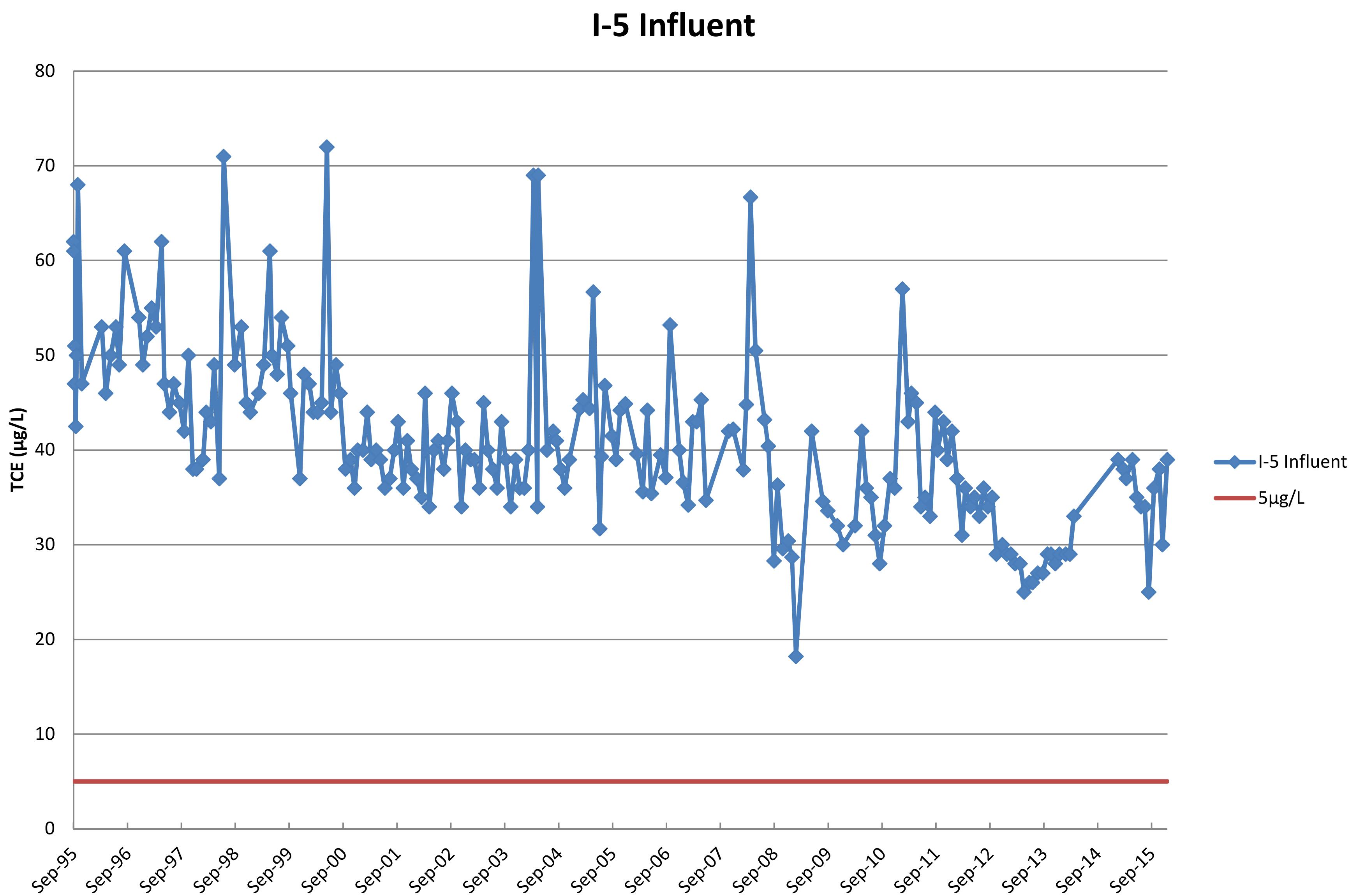

PW-7
TCE µg/L
60
50
40
30
20
10
0
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
PW-7
5µg/L

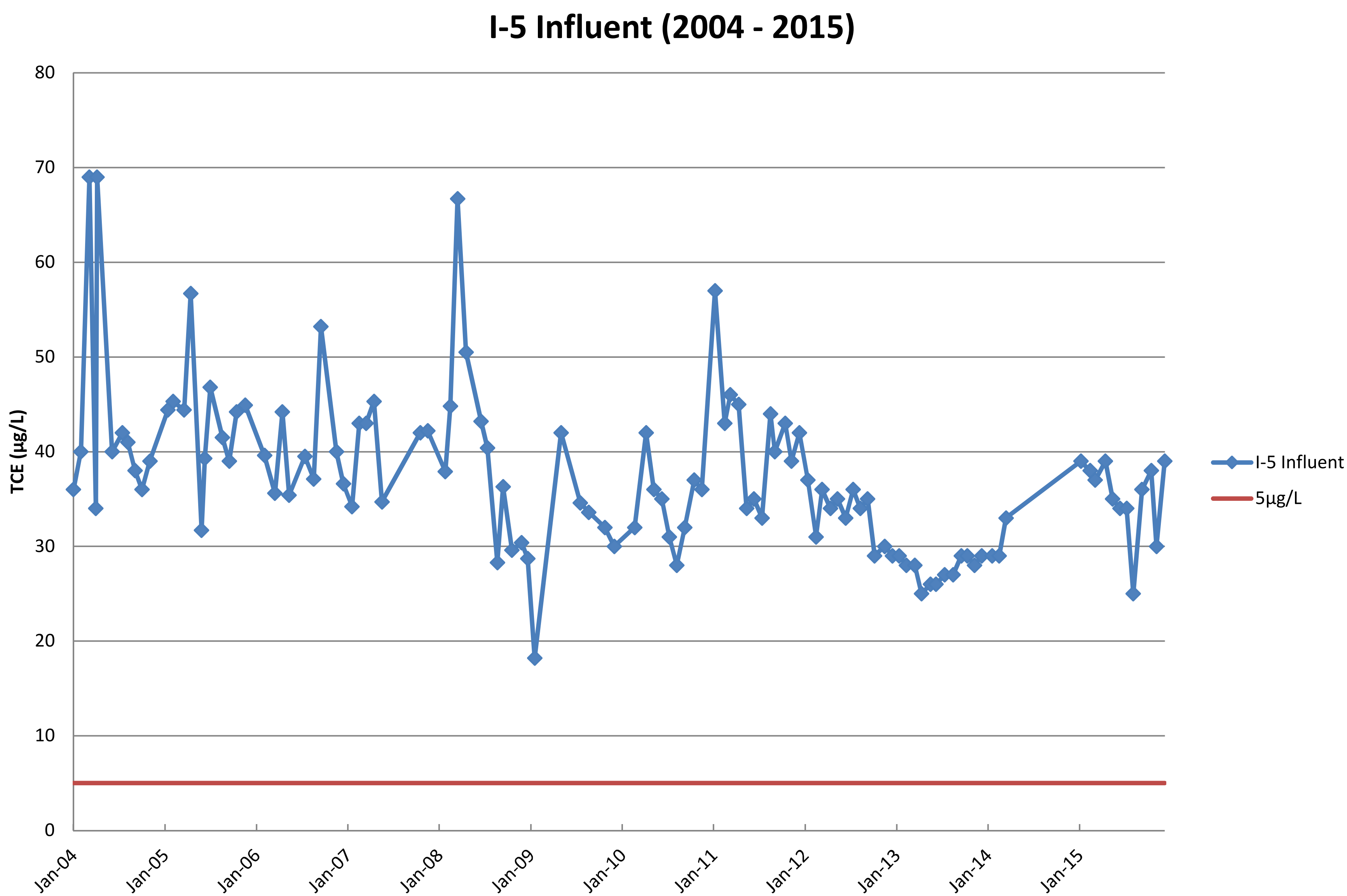

PW-8
45
40
35
30
25
20
15
10
5
0
TCE µg/L
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
PW-8
5µg/L

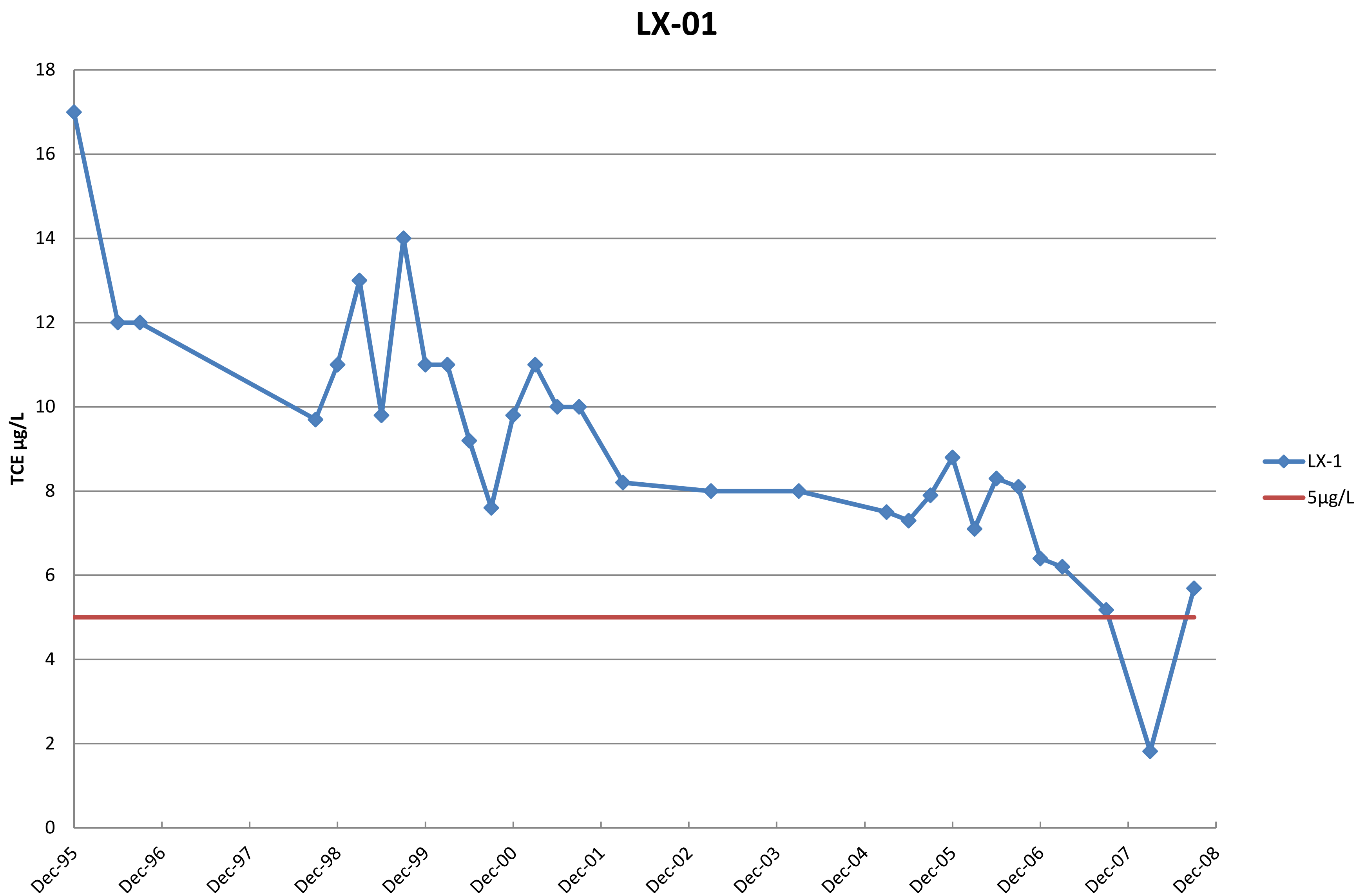

I-5 Effluent
TCE (µg/L)
6
5
4
3
2
1
0
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
I-5 Effluent
5µg/L

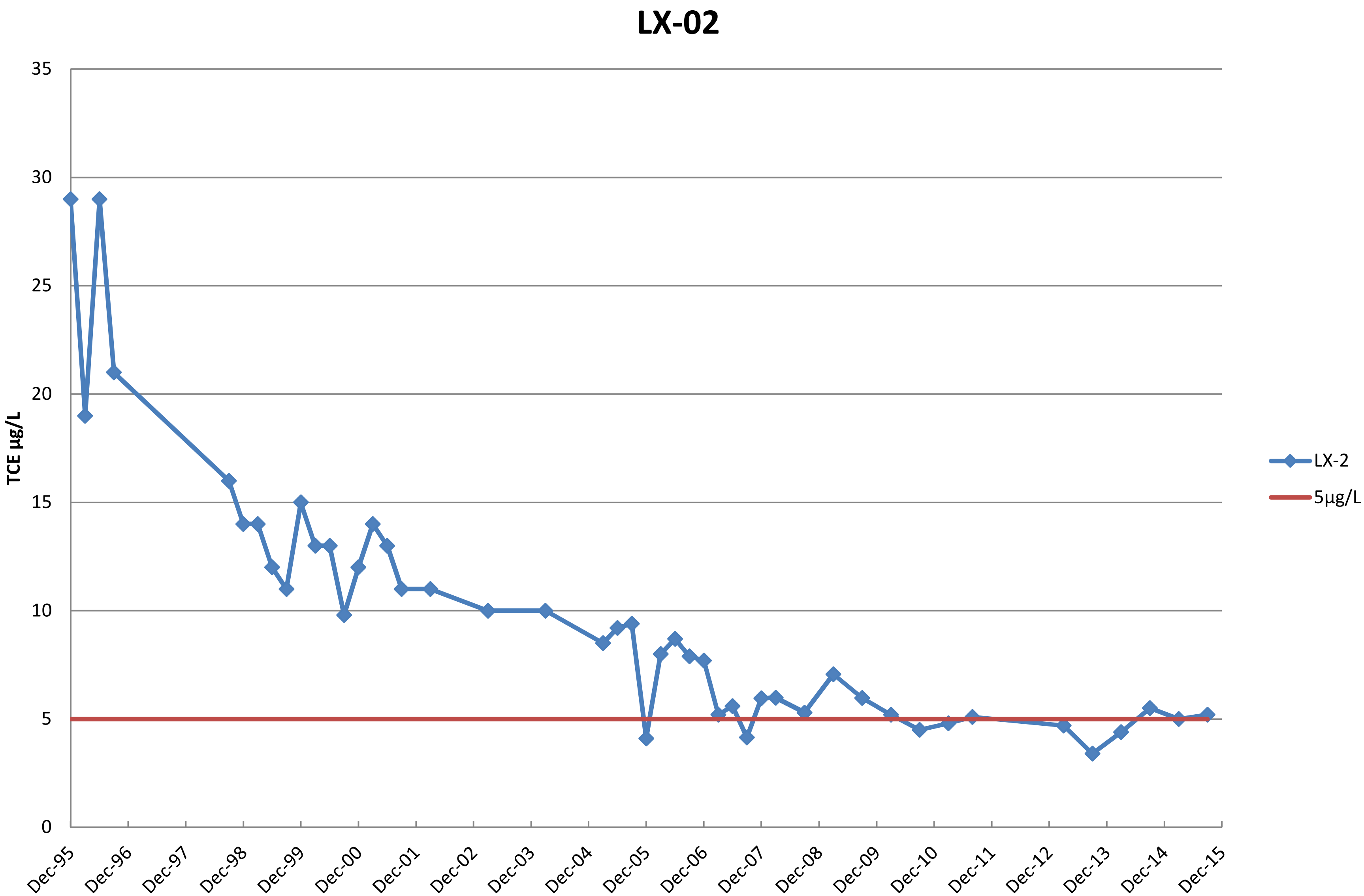
I-5 Effluent (2004 - 2015)

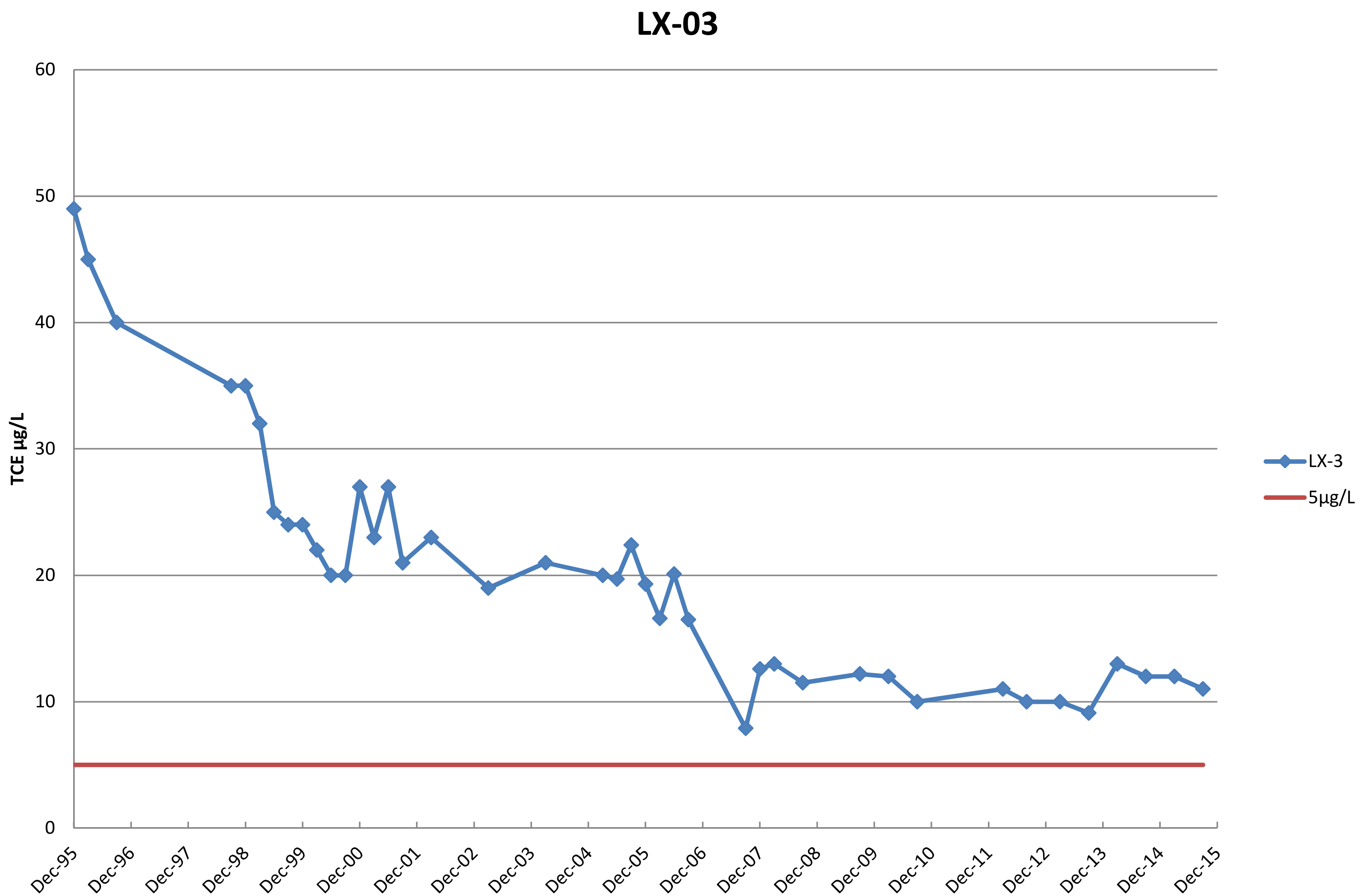


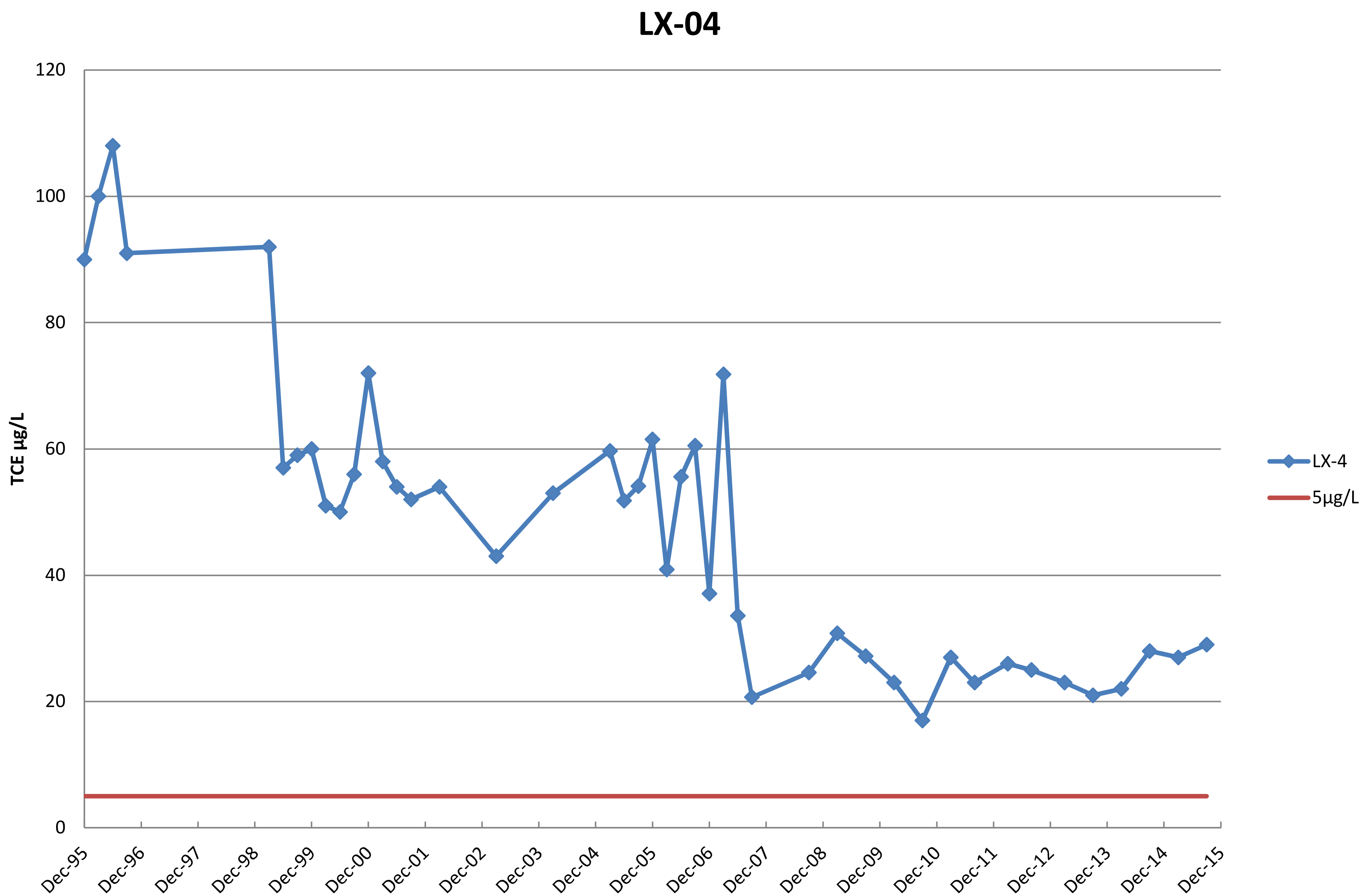

I-5 Influent
TCE (µg/L)
80
70
60
50
40
30
20
10
0
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
I-5 Influent
5µg/L

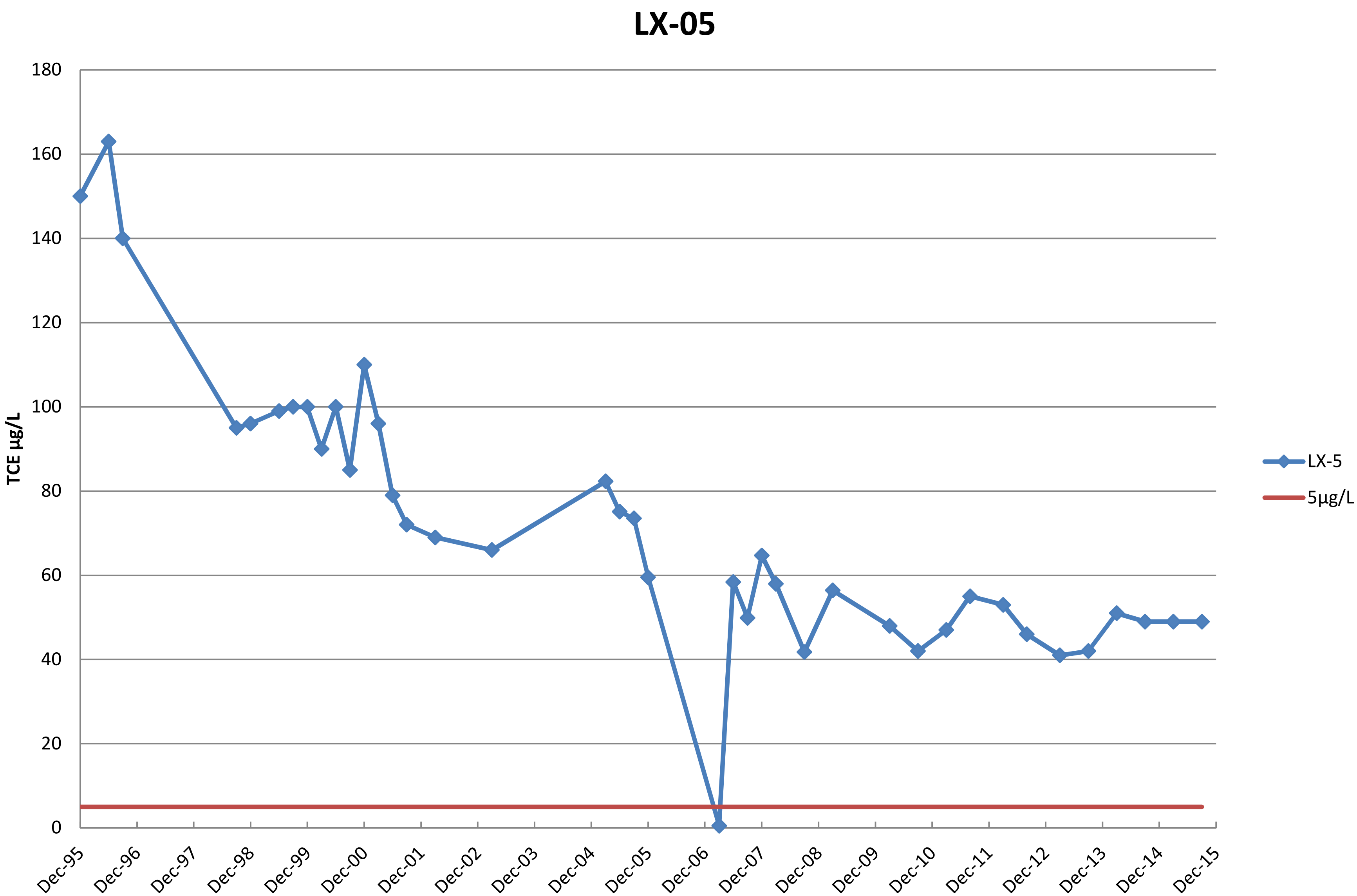

I-5 Influent (2004 - 2015)
TCE (µg/L)
80
70
60
50
40
30
20
10
0
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
I-5 Influent
5µg/L


LX-01
TCE µg/L
18
16
14
12
10
8
6
4
2
0
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
LX-1
5µg/L

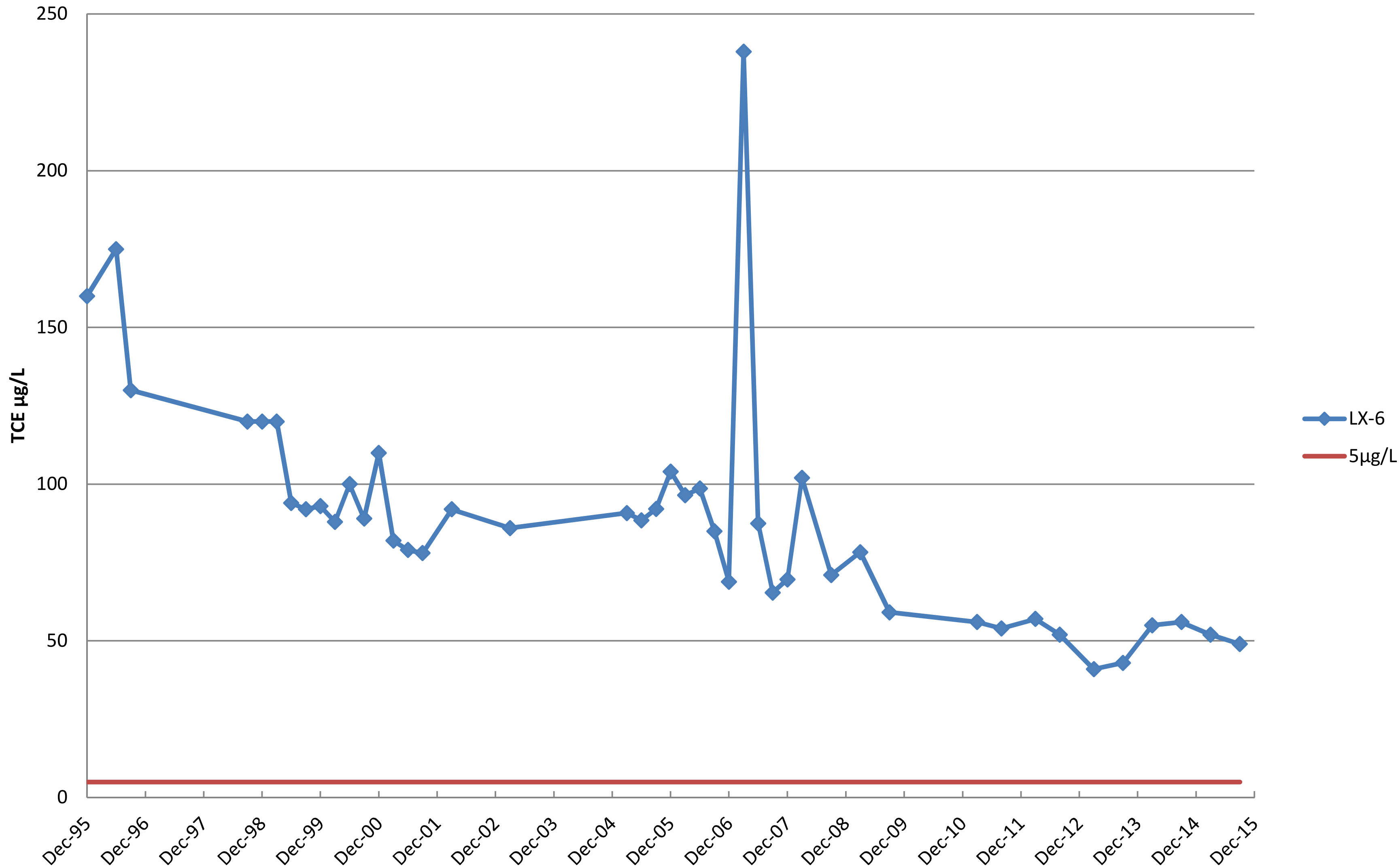

LX-02
35
30
25
20
15
10
5
0
TCE µg/L
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-2
5µg/L

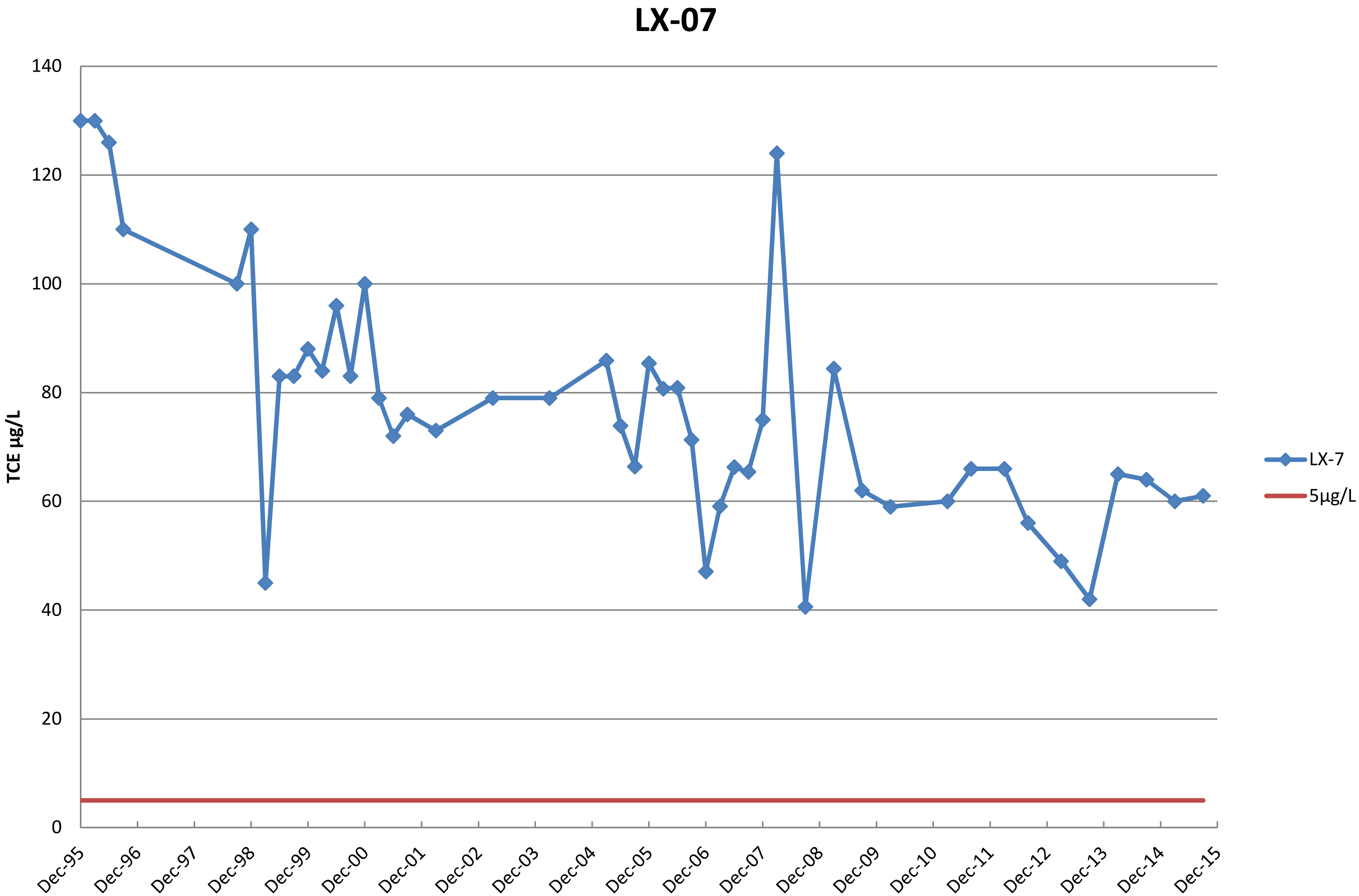

LX-03
TCE µg/L
60
50
40
30
20
10
0
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-3
5µg/L

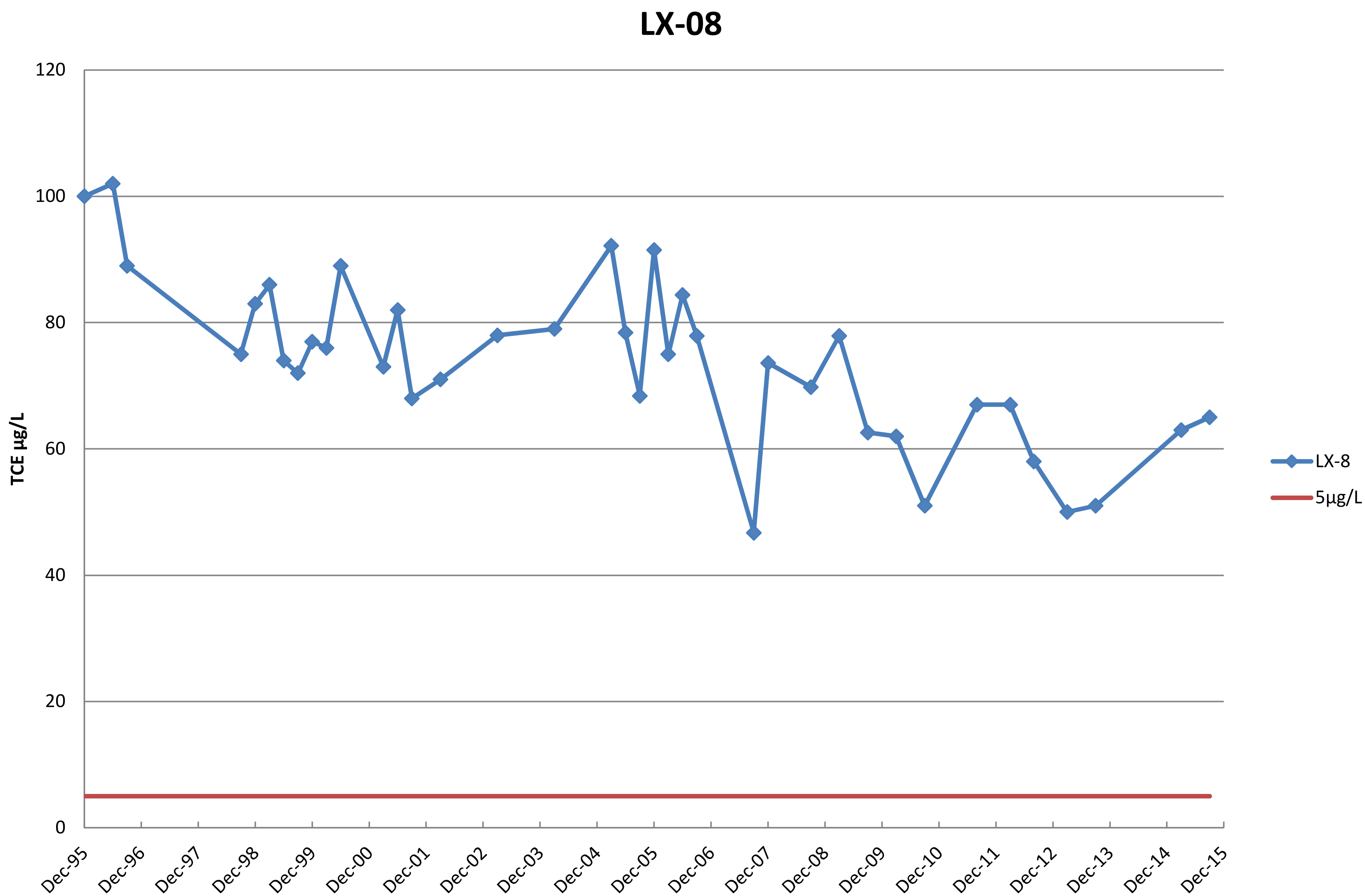

LX-04
TCE µg/L
0
20
40
60
80
100
120
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-4
5µg/L


LX-05
TCE µg/L
180
160
140
120
100
80
60
40
20
0
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-5
5µg/L

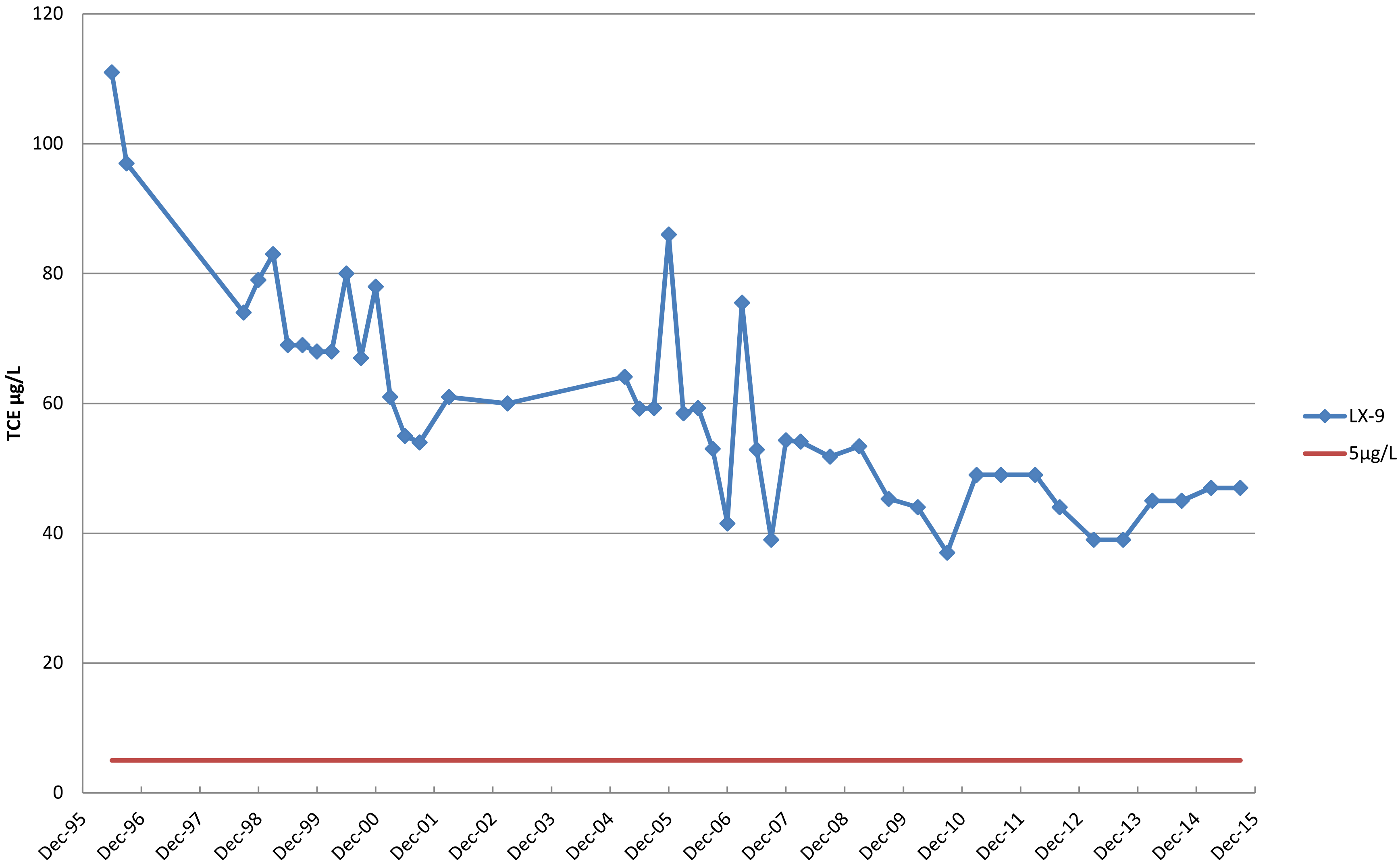
LX-06


250
200
150
100
50
0
TCE µg/L
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-6
5µg/L

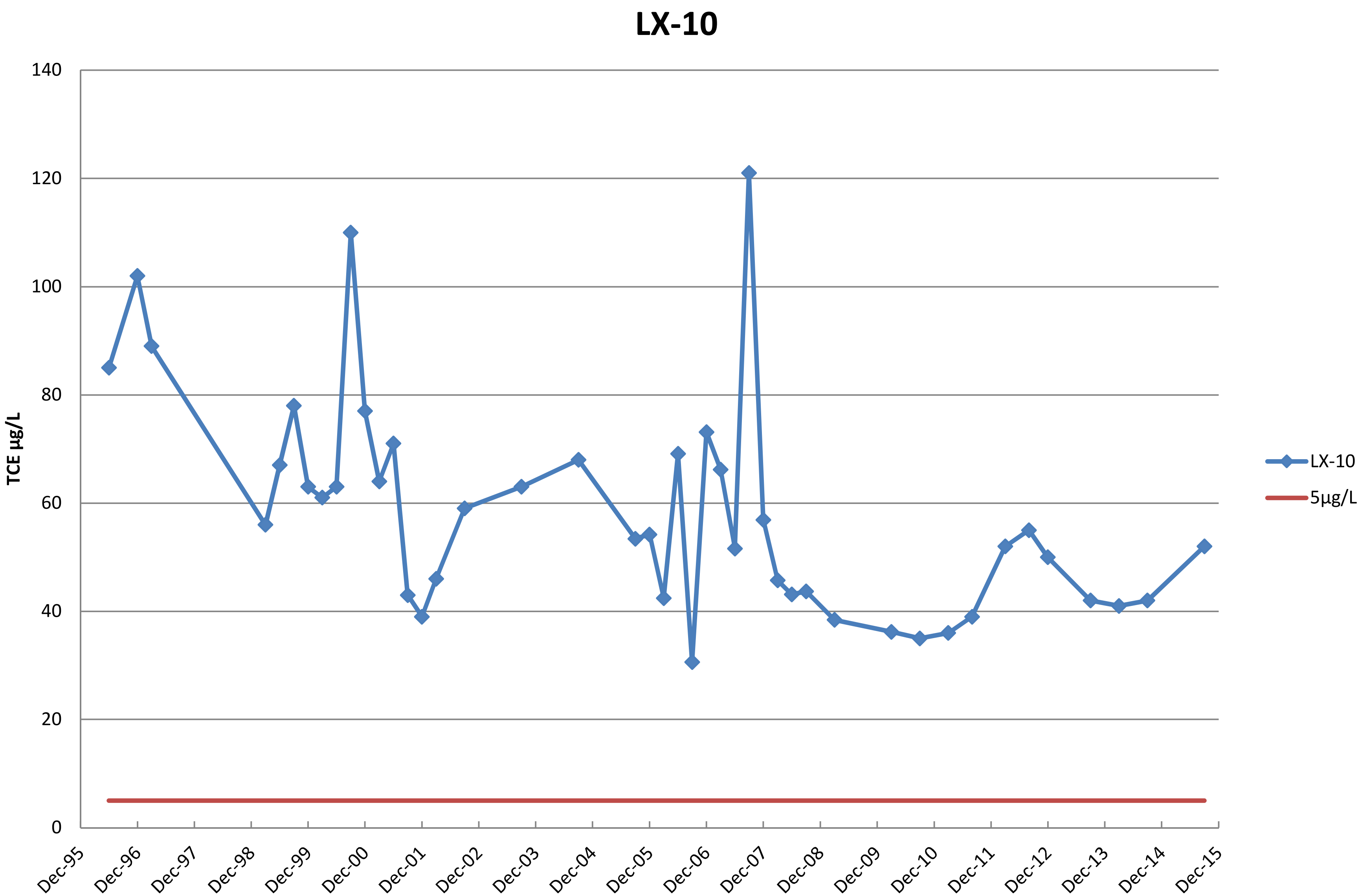

LX-07
140
120
100
80
60
40
20
0
TCE µg/L
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-7
5µg/L


LX-08
TCE µg/L
120
100
80
60
40
20
0
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-8
5µg/L

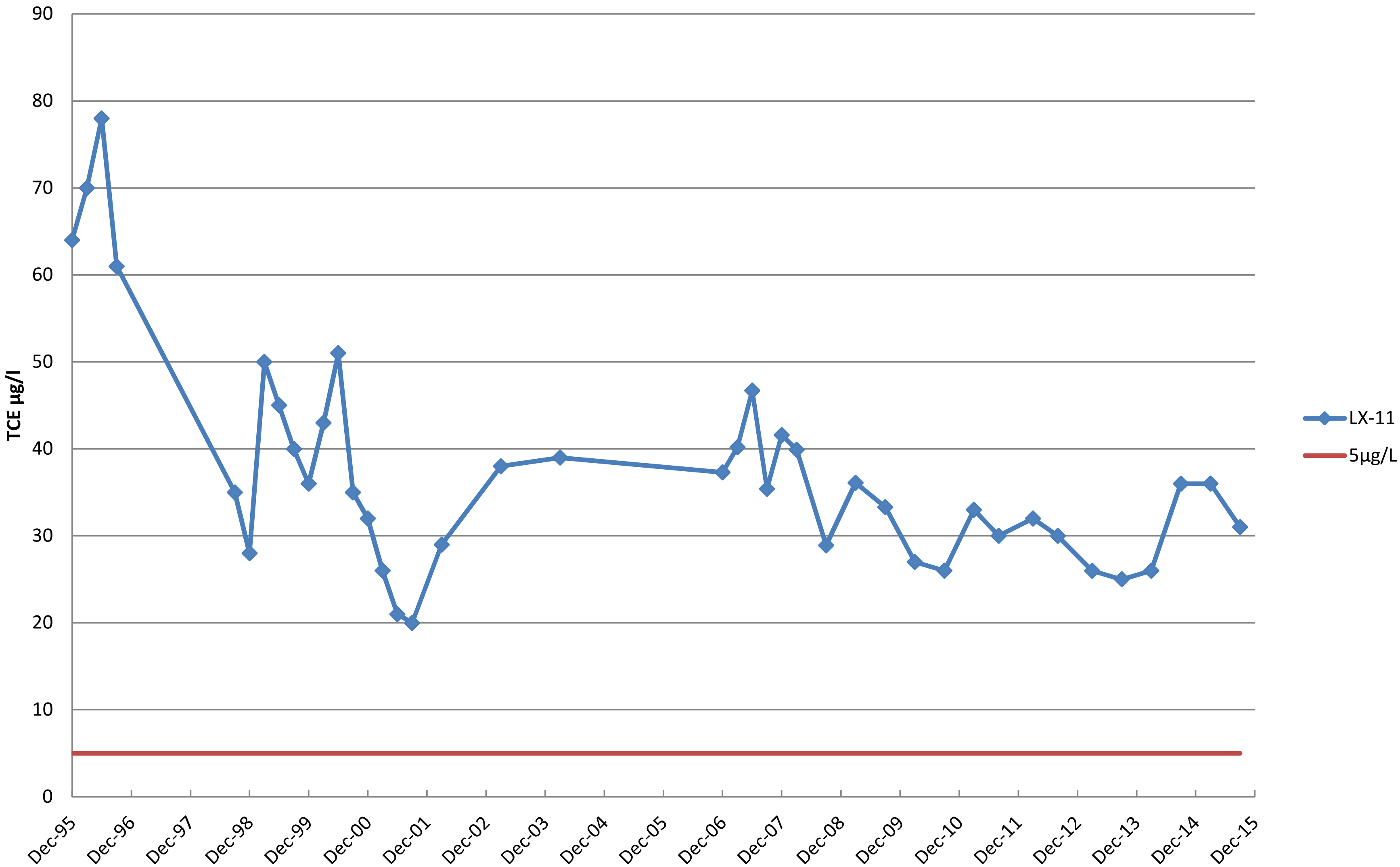
LX-09

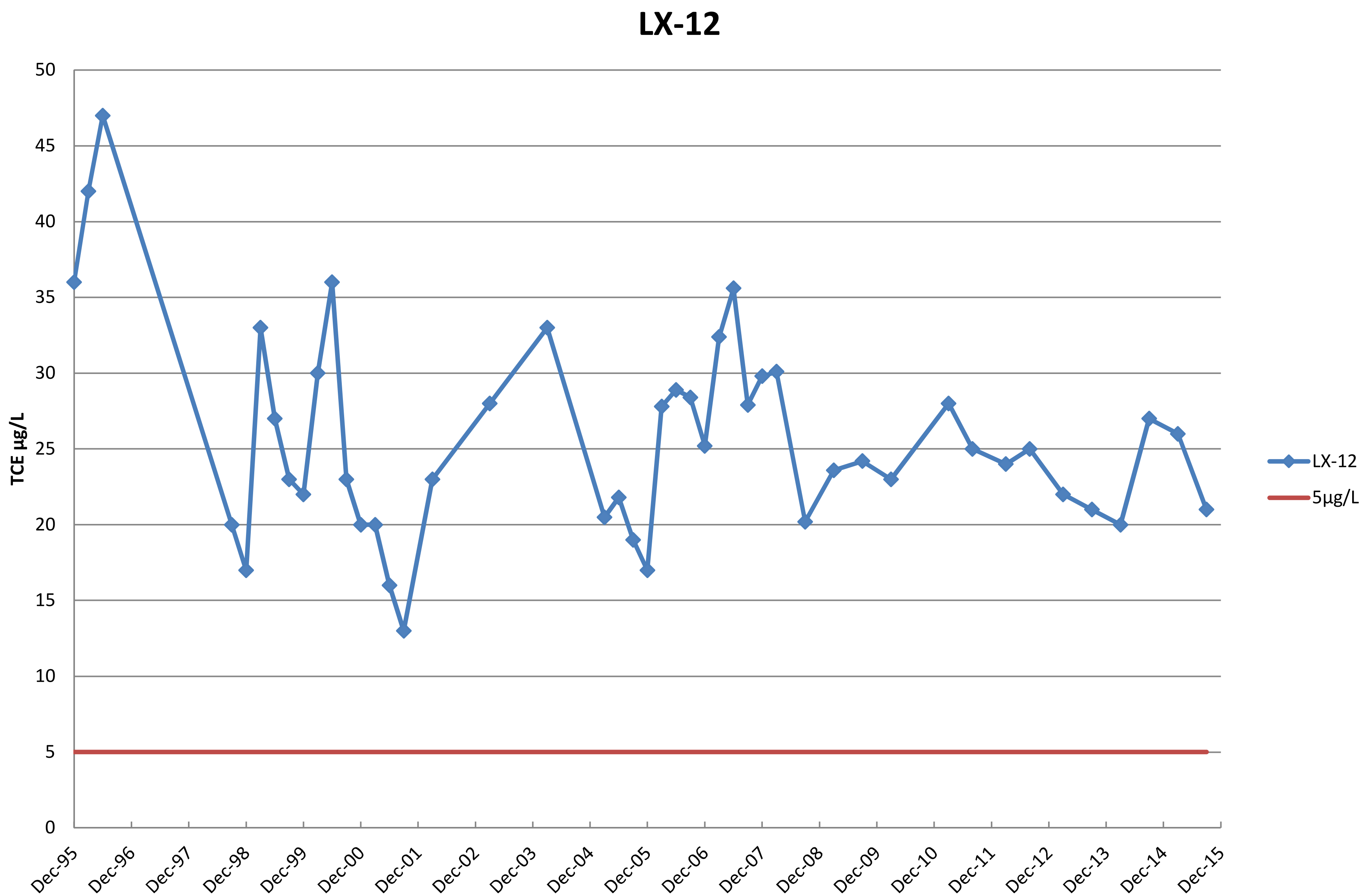


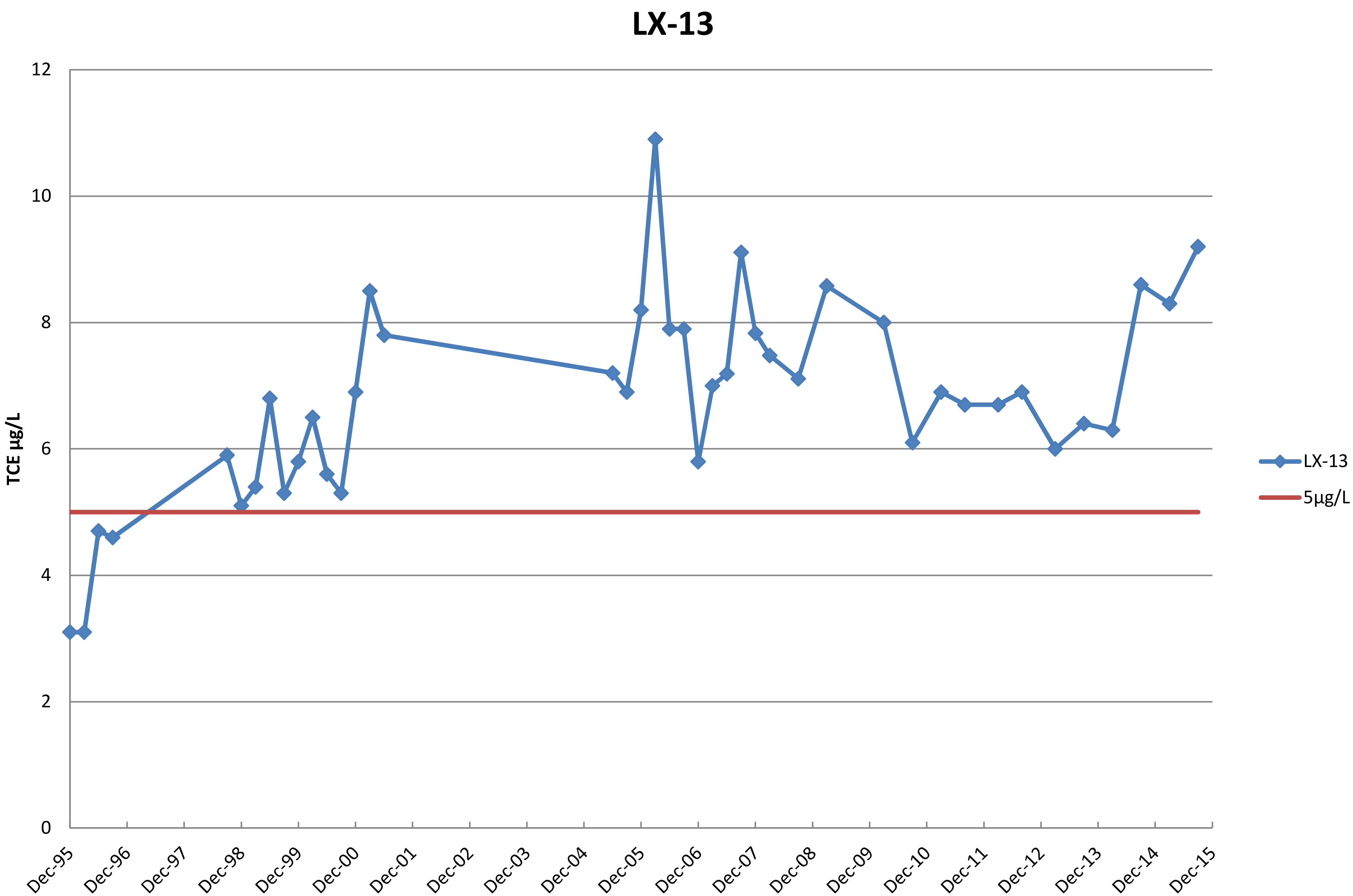
TCE µg/L
120
100
80
60
40
20
0
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-9
5µg/L

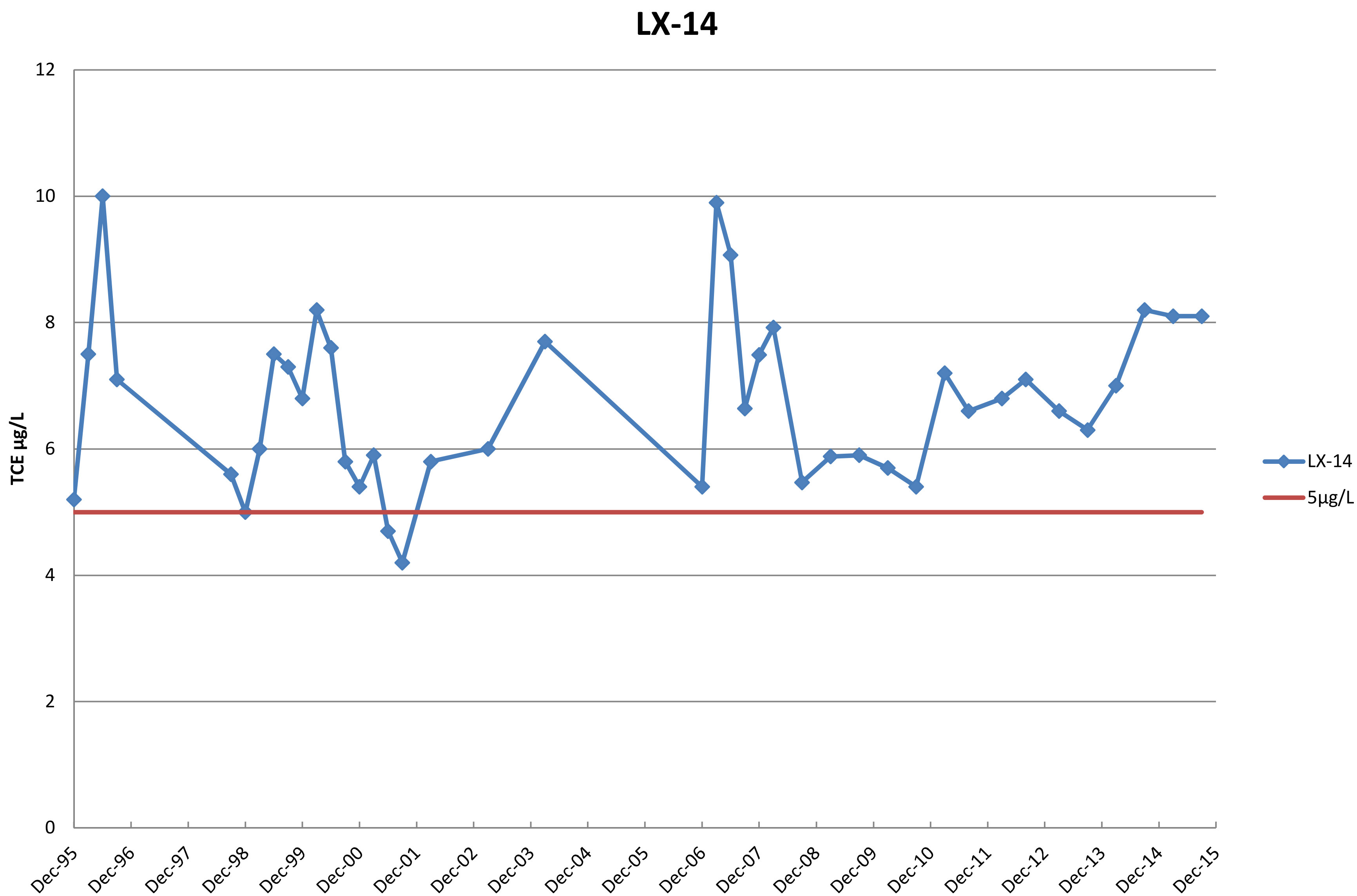

LX-10
140
120
100
80
60
40
20
0
TCE µg/L
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-10
5µg/L

LX-11


90
80
70
60
50
40
30
20
10
0
TCE µg/l
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-11
5µg/L


LX-12
50
45
40
35
30
25
20
15
10
5
0
TCE µg/L
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-12
5µg/L


LX-13
12
10
8
6
4
2
0
TCE µg/L
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-13
5µg/L


LX-14
TCE µg/L
12
10
8
6
4
2
0
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-14
5µg/L

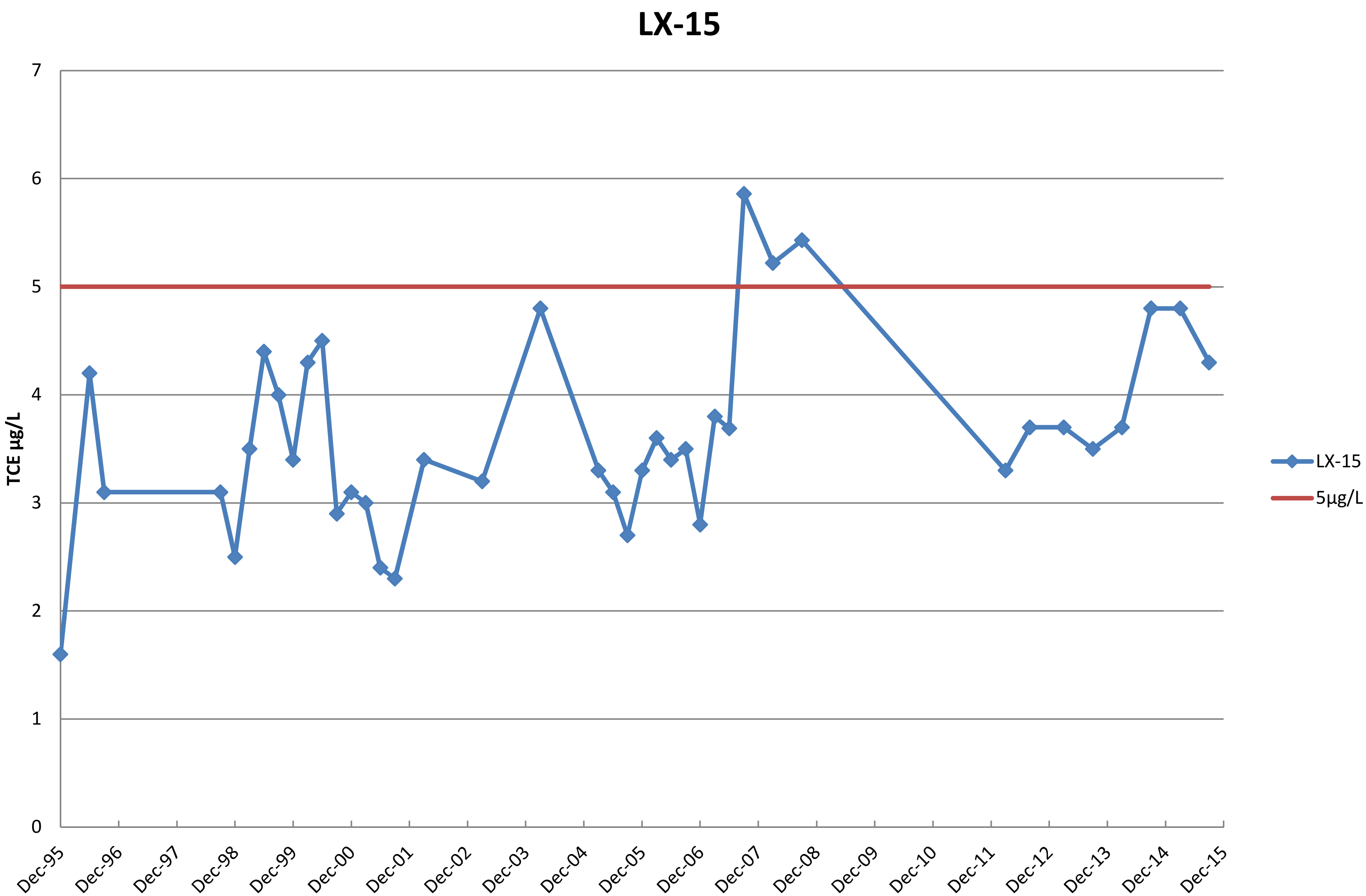

LX-15
TCE µg/L
7
6
5
4
3
2
1
0
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
LX-15
5µg/L

Figure 3-1. TCE in Source Area Groundwater

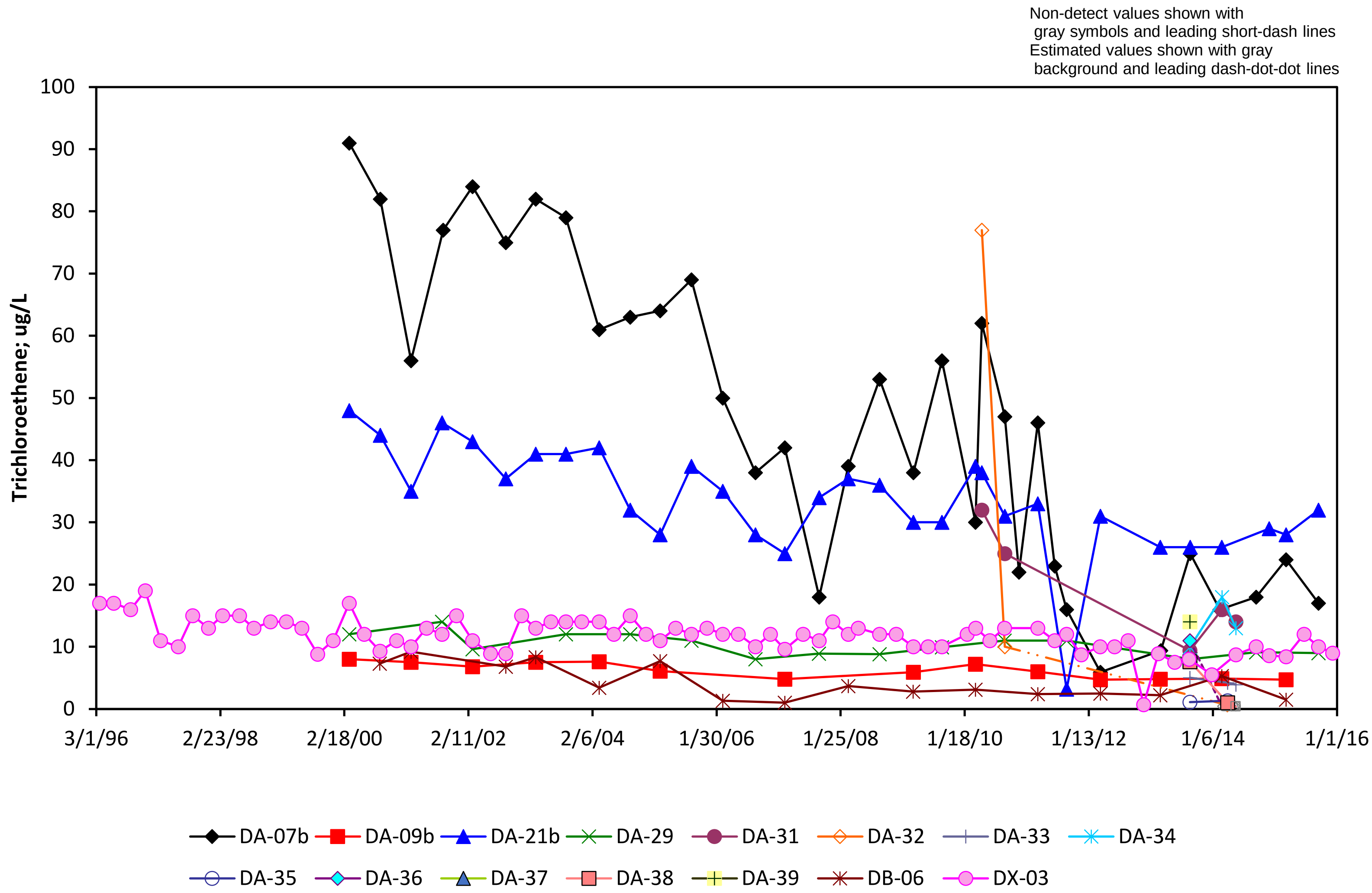


Figure 3-2. cis-1,2-DCE in Source Area Groundwater

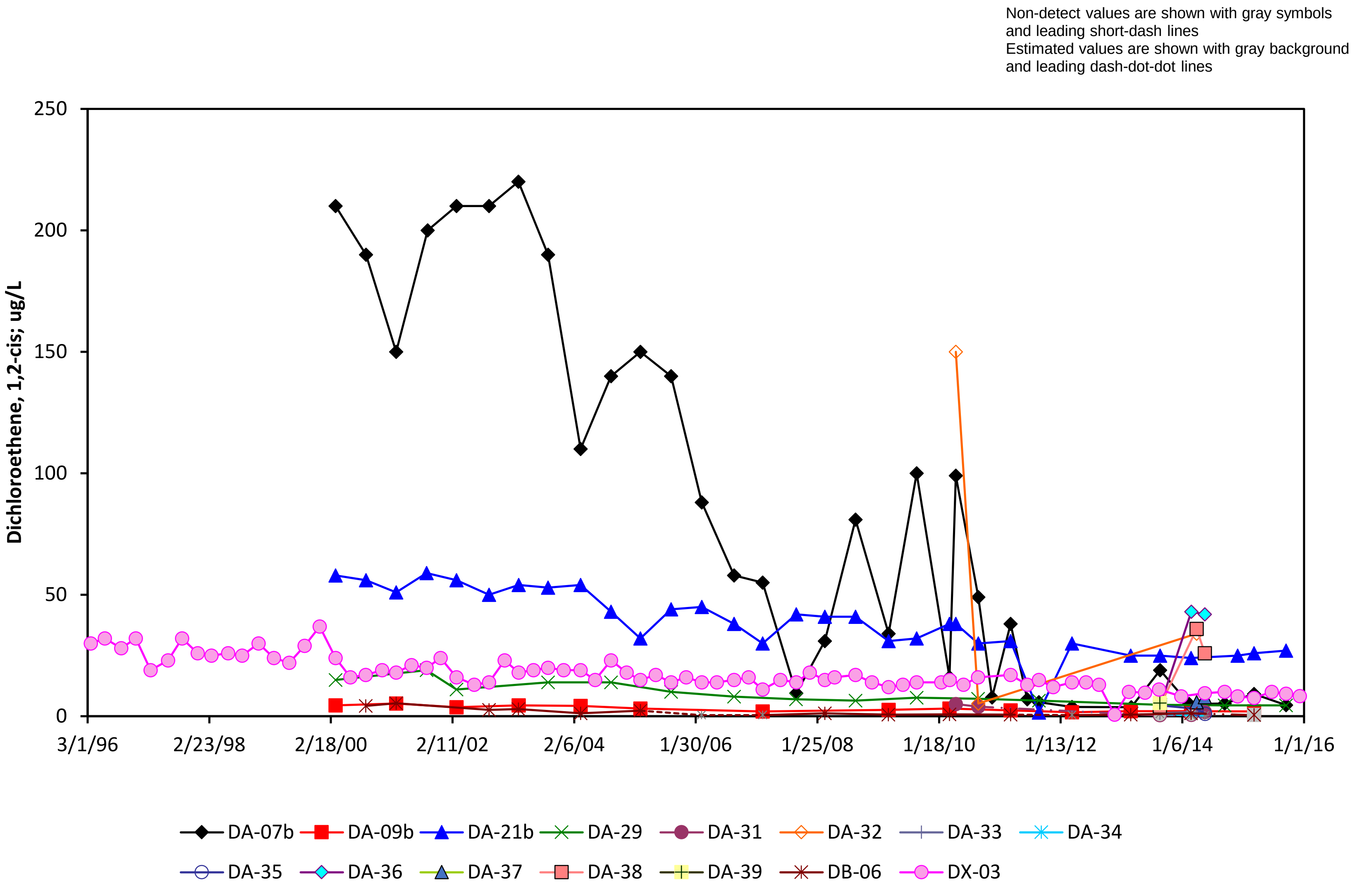


Figure 3-3. TCE in Distal Groundwater

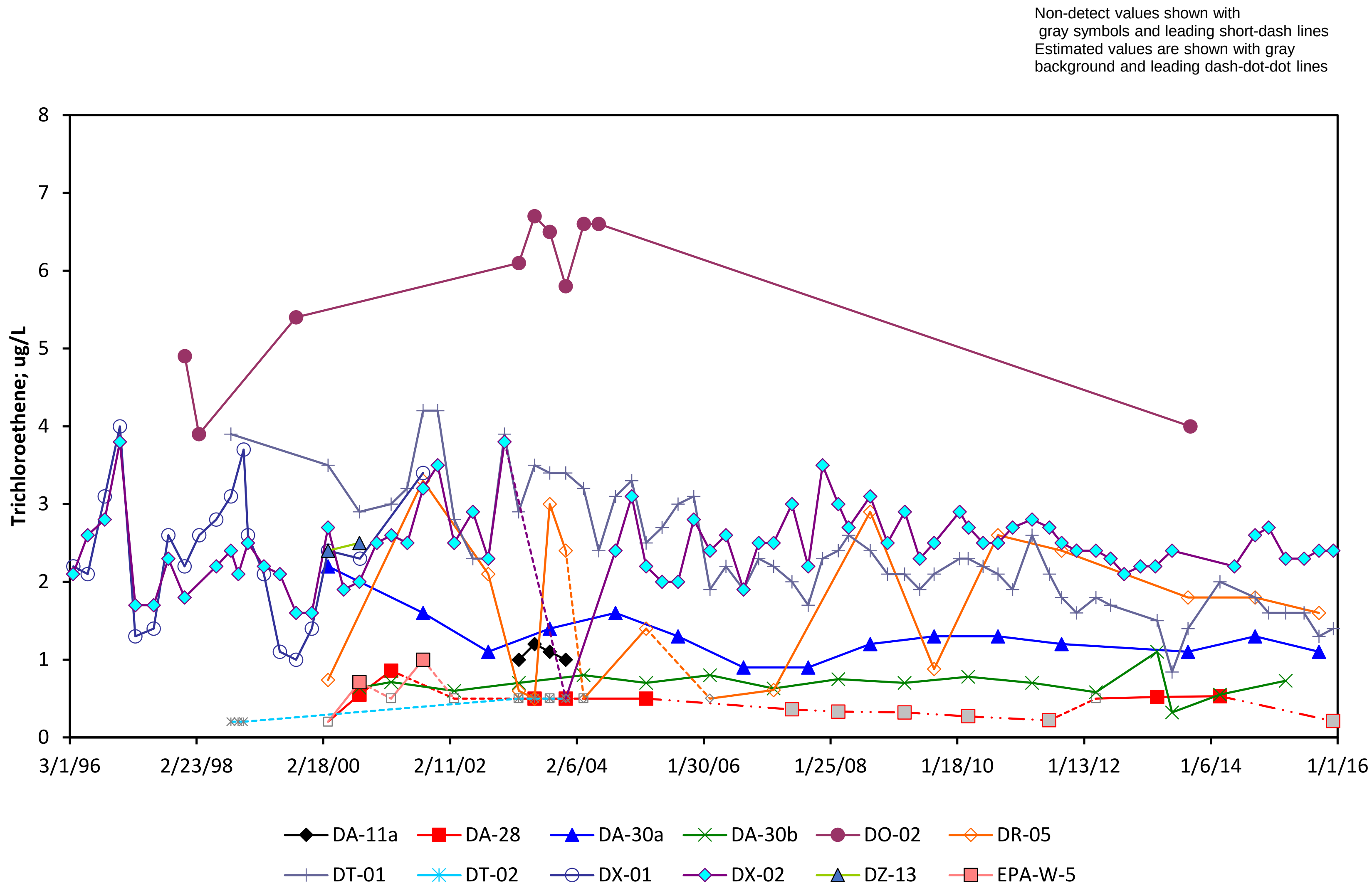


Figure 3-4. cis-1,2-DCE in Distal Groundwater

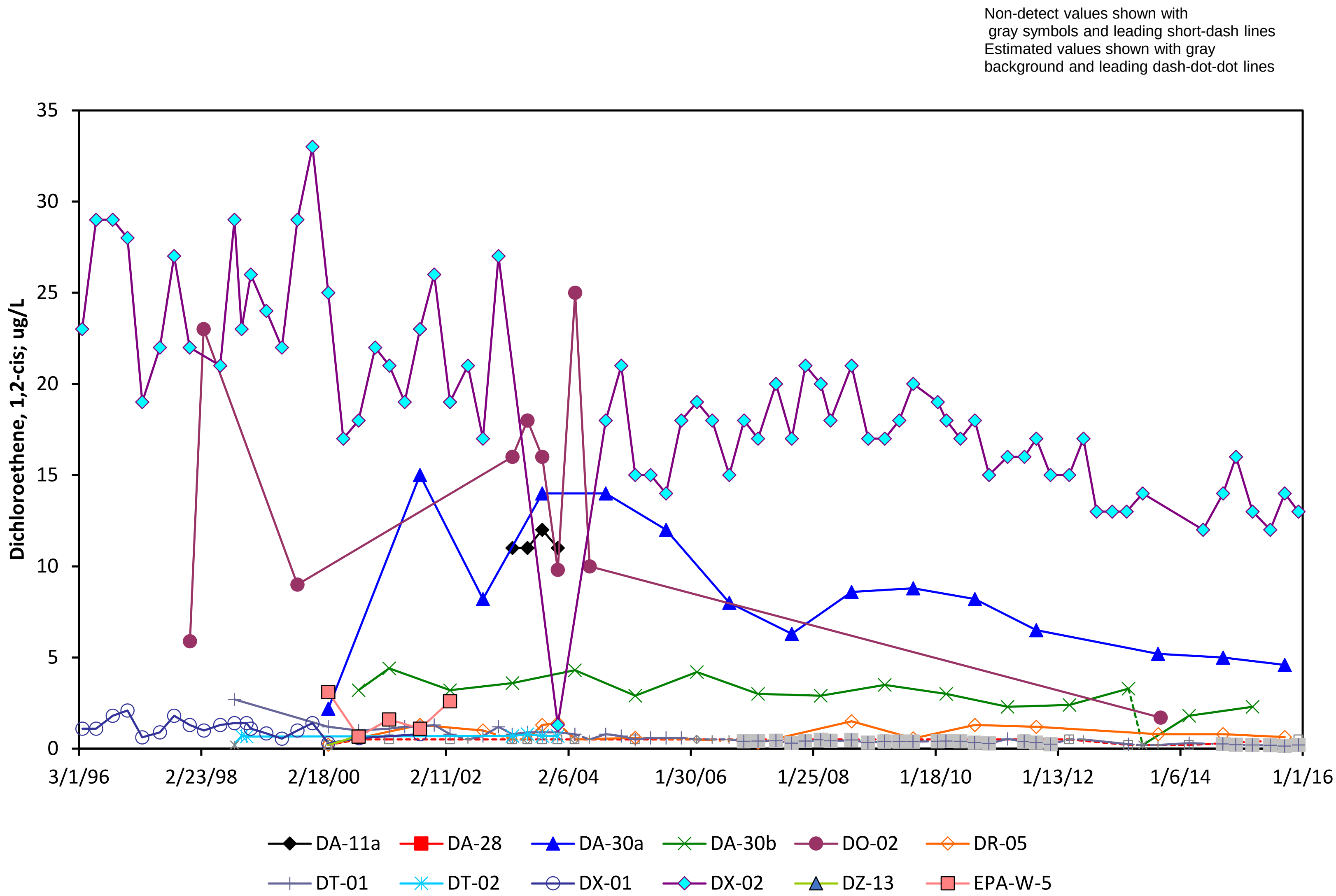


Table 8

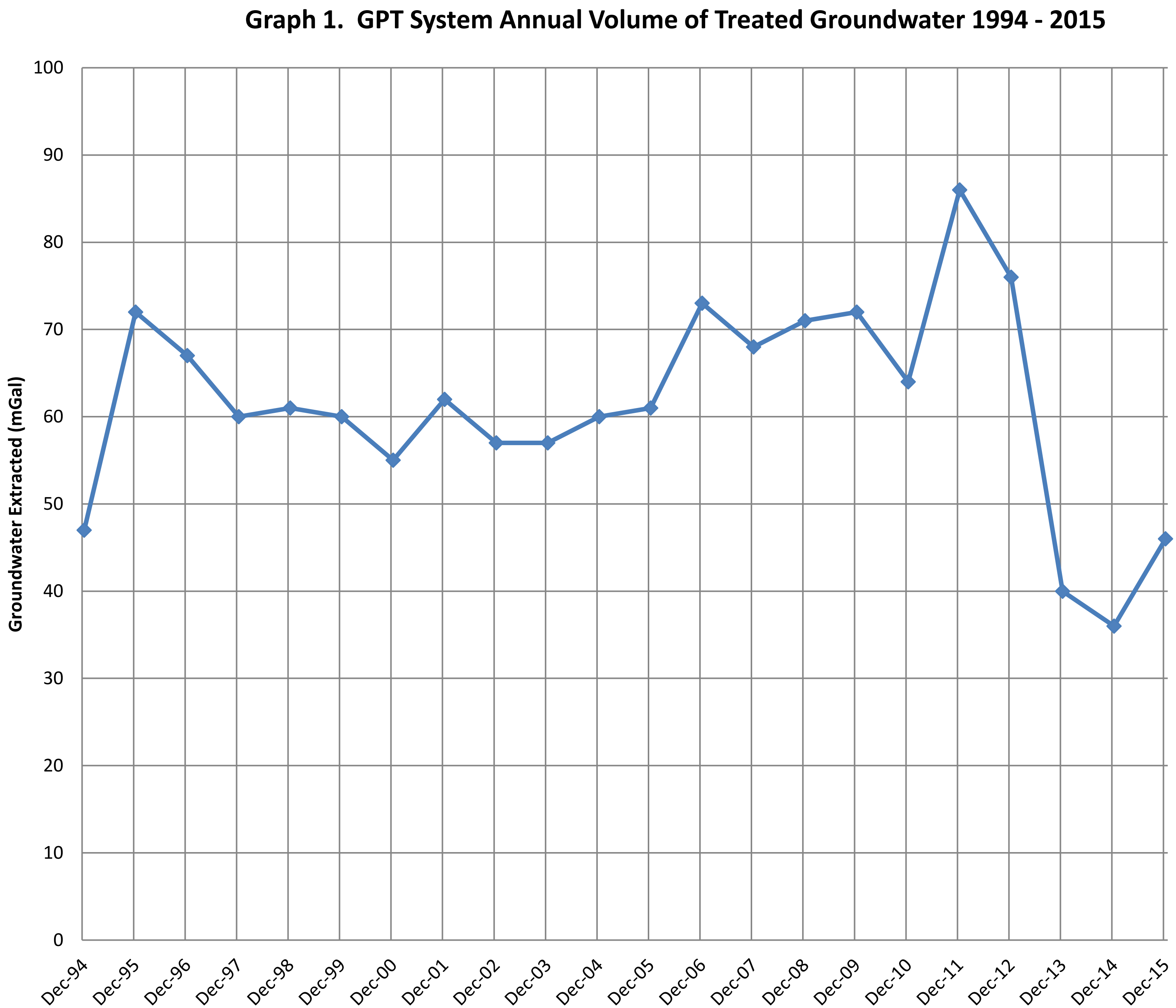
TCE Results Statistics

Well ID	DA-7b	DA-9b	DA-21b	DA-28	DA-29	DA-30a	DA-30b	DB-6	DR-05
Descriptive Statistics									
First Sample Date	3/30/1995	3/30/1995	3/30/1995	3/30/1995	3/30/1995	3/30/1995	3/30/1995	3/30/1995	3/30/1995
Last Sample Date	9/16/2015	3/10/2015	9/16/2015	12/7/2015	9/16/2015	9/16/2015	3/10/2015	3/10/2015	9/16/2014
Number of Samples	45	23	42	34	24	25	25	26	28
Number of NDs	0	0	0	11	0	1	2	0	4
Sample Mean	46.47	6.69	32.57	0.54	10.34	1.48	0.75	4.86	1.61
Standard Deviation	24.55	1.50	9.64	0.34	1.83	0.77	0.22	2.66	1.01
Minimum Concentration	0.98	4.7	3.2	0.2	8	0.8	0.32	1	0.2
Maximum Concentration	91	10	48	1.5	14	4.4	1.2	10	3.3
Date*	3/17/2000	3/30/1995	9/17/2001	12/18/1995	9/17/2001	3/30/1995	9/19/1996	9/19/1995	9/17/2001
Distribution of Data									
P Value	0.1573	0.1733	0.0004	<0.0001	0.0686	<0.0001	0.2542	0.1487	0.0151
Normally Distributed?	Yes	Yes	No	No	Yes	No	Yes	Yes	No
Log P Value	-	-	<0.0001	0.0157	-	0.0049	-	-	0.0136
Log Normally Distributed?	-	-	No	No	-	No	-	-	No
Trend Analysis									
Linear Regression P Value	0.0012	0.0001	-	-	0.0938	-	0.0851	0.0055	-
Slope	-0.00517	-0.000457	-	-	-0.00027	-	-3.2119E-05	-0.0006036	-
Trend**	Down	Down	-	-	Down	-	Down	Down	-
Statistically Significant?	Yes	Yes	-	-	No	-	No	Yes	-
Tau Statistic	-	-	-0.238	-0.252	-	-0.242	-	-	0.053
Two Tailed P Value	-	-	0.0283	0.0415	-	0.0996	-	-	0.6923
Trend	-	-	Down	Down	-	Down	-	-	Up
Statistically Significant?	-	-	No	No	-	No	-	-	No

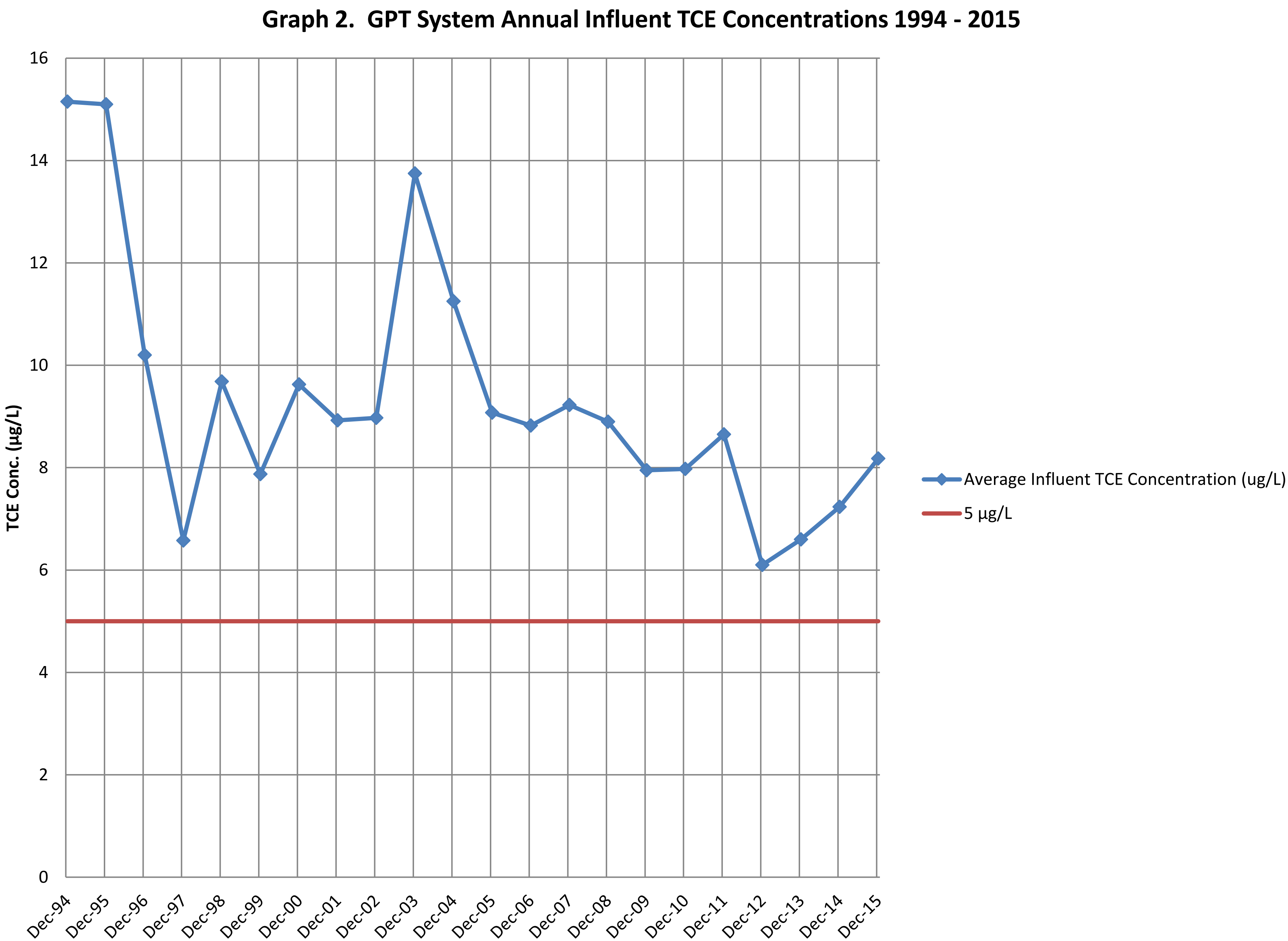
Notes:
* Date sample with highest concentration of TCE was collected from monitoring well
** Trend for entire dataset not taking discontinuities into consideration

Abbreviations and Acronyms:
ND – non-detect
\- = not applicable
TCE – trichloroethene

ALGT


Graph 1. GPT System Annual Volume of Treated Groundwater 1994 - 2015
Groundwater Extracted (mGal)
0
10
20
30
40
50
60
70
80
90
100
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15

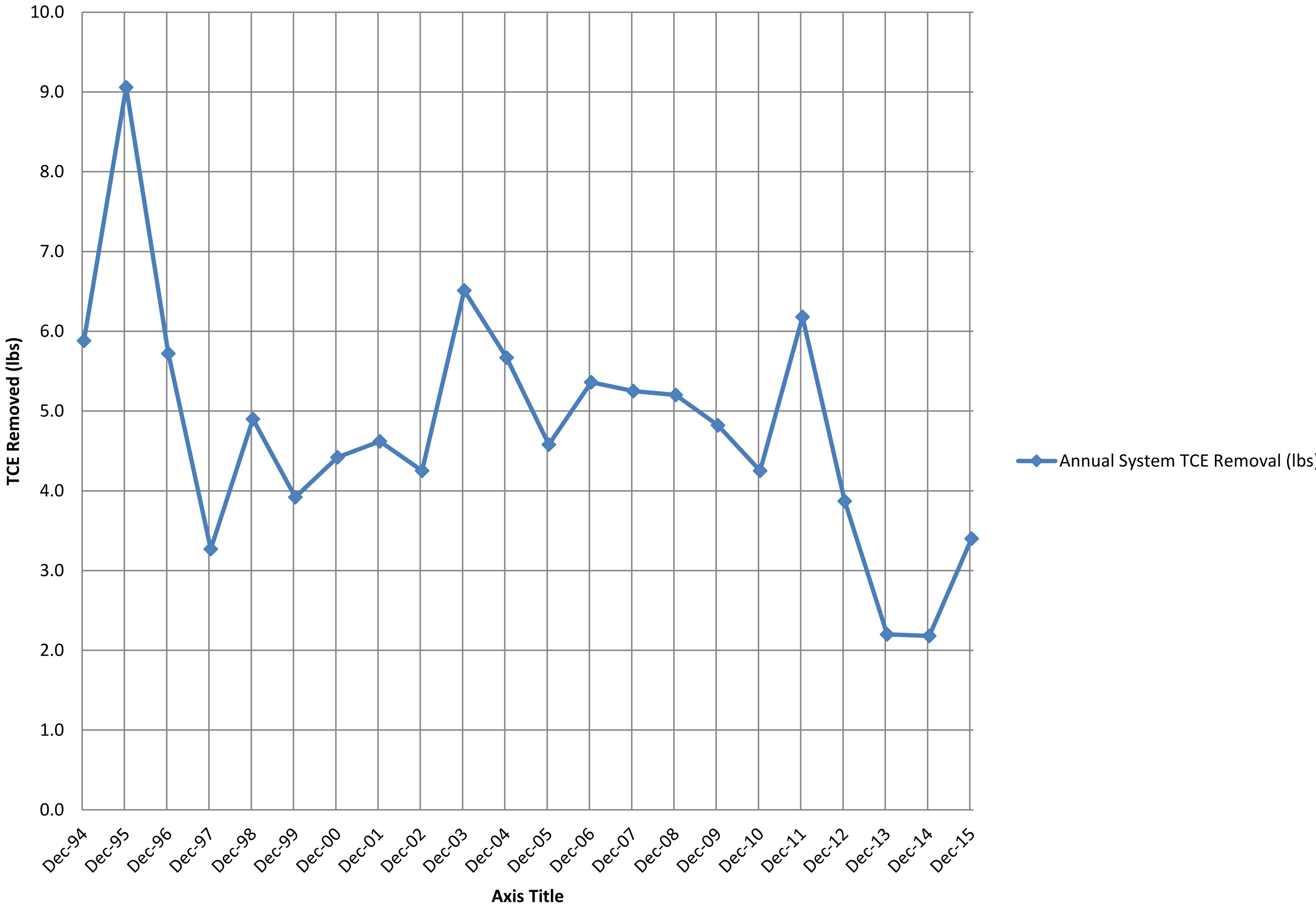
ALGT



Graph 2. GPT System Annual Influent TCE Concentrations 1994 - 2015
TCE Conc. (µg/L)
16
14
12
10
8
6
4
2
0
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
Average Influent TCE Concentration (ug/L)
5 µg/L

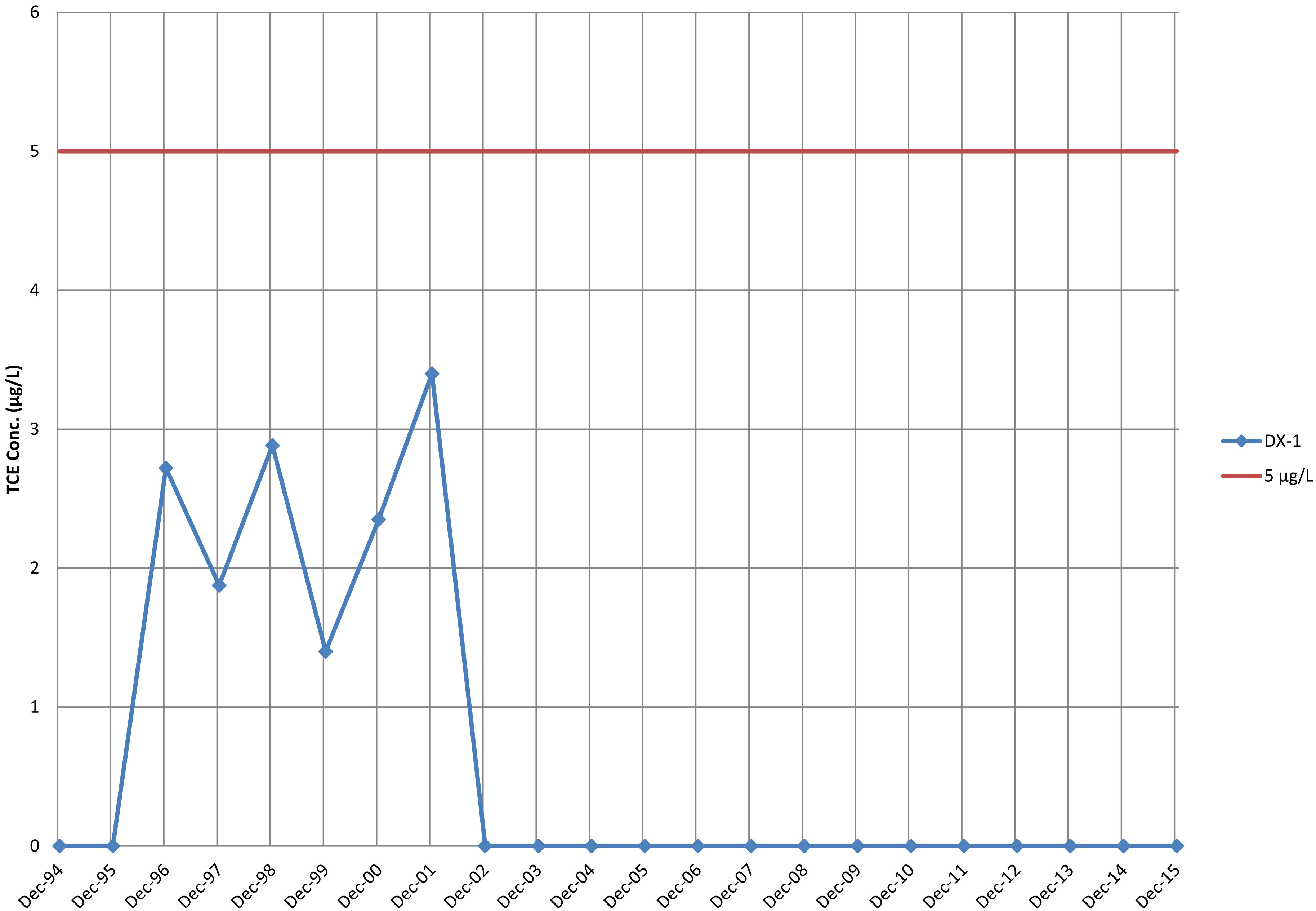
ALGT

Graph 3. GPT System Annual TCE Removal 1994 - 2015

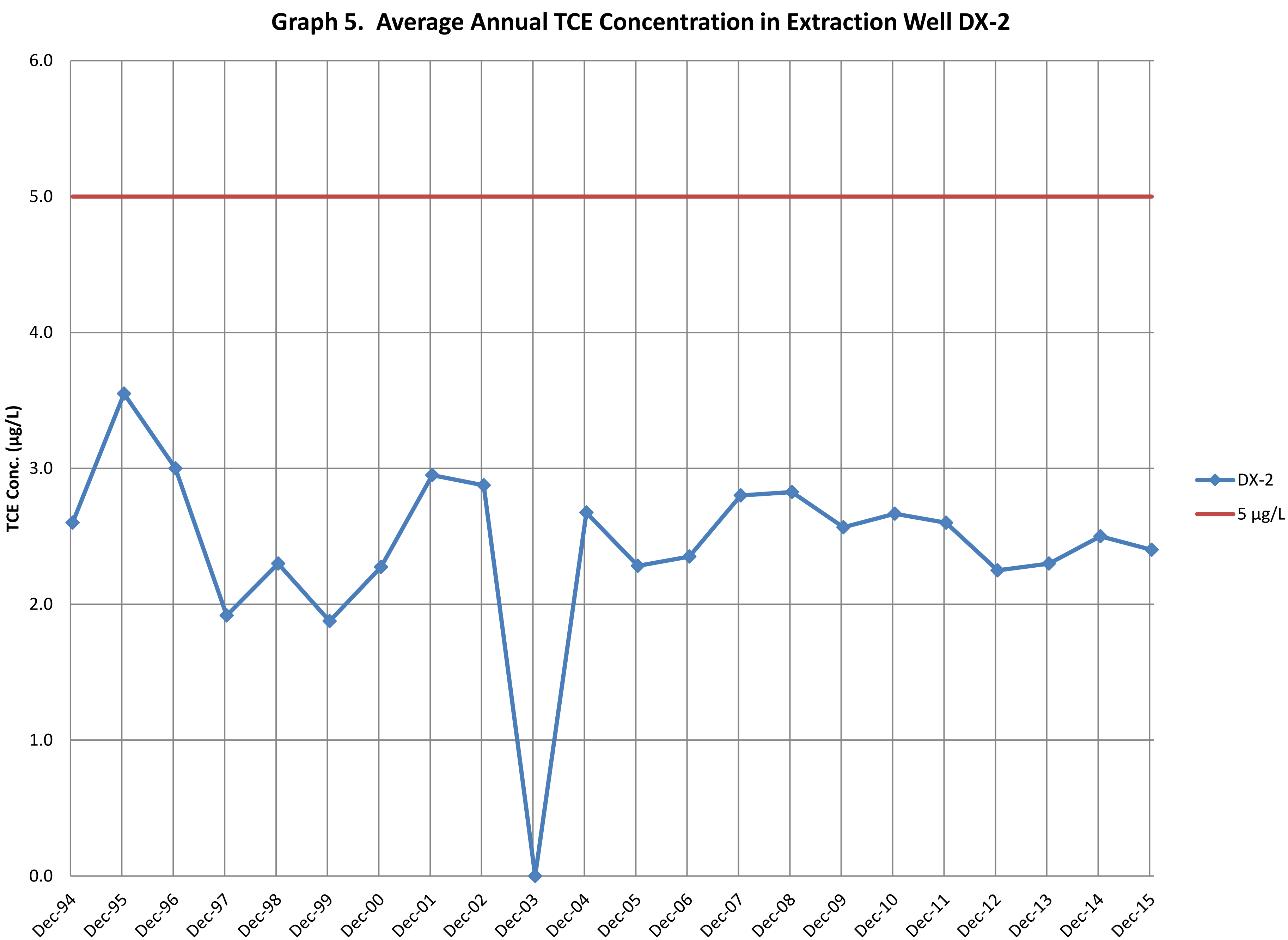


ALGT

Graph 4. Average Annual TCE Concentration in Extraction Well DX-1

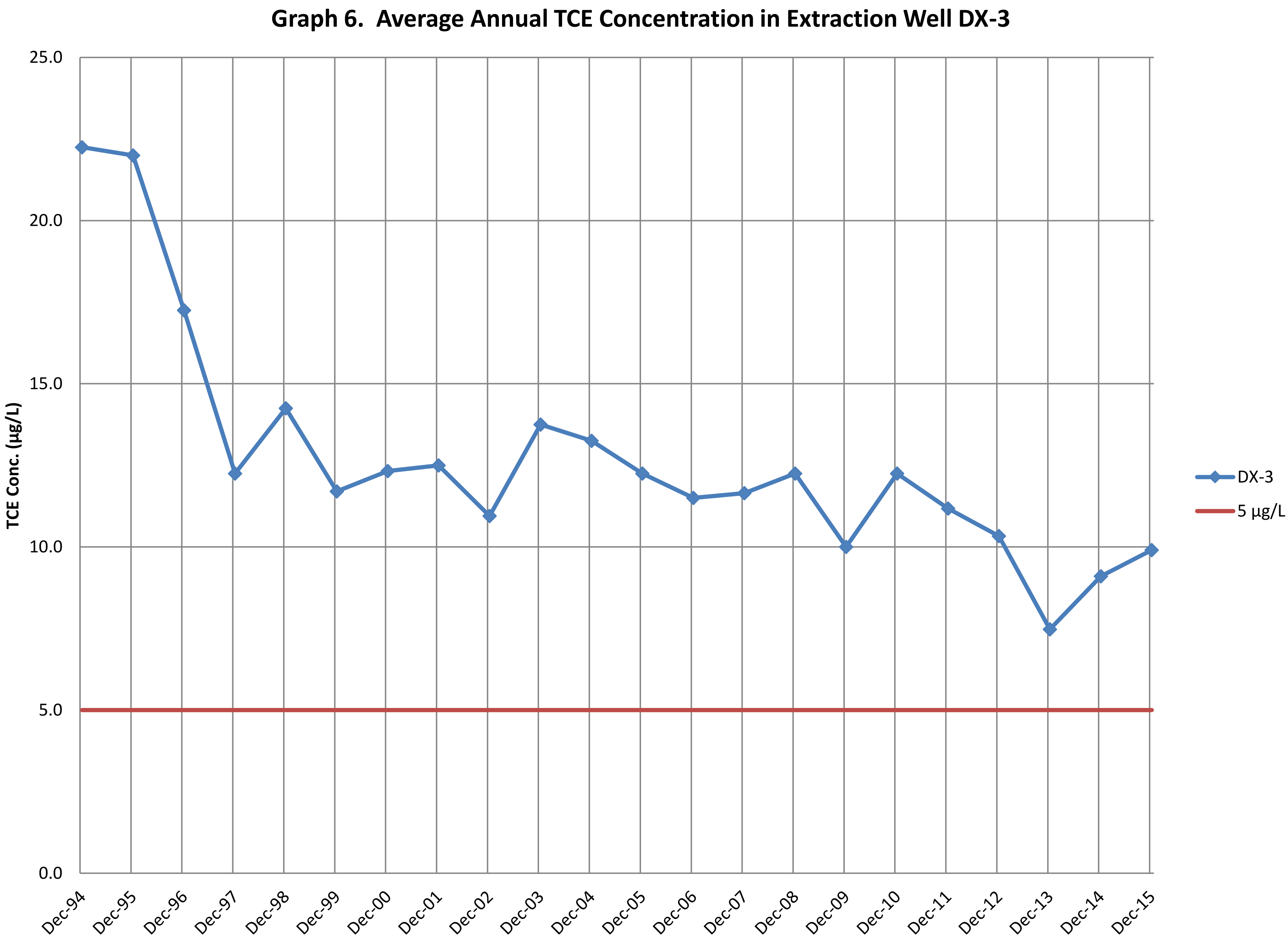


ALGT



Graph 5. Average Annual TCE Concentration in Extraction Well DX-2
TCE Conc. (µg/L)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
DX-2
5 µg/L

ALGT



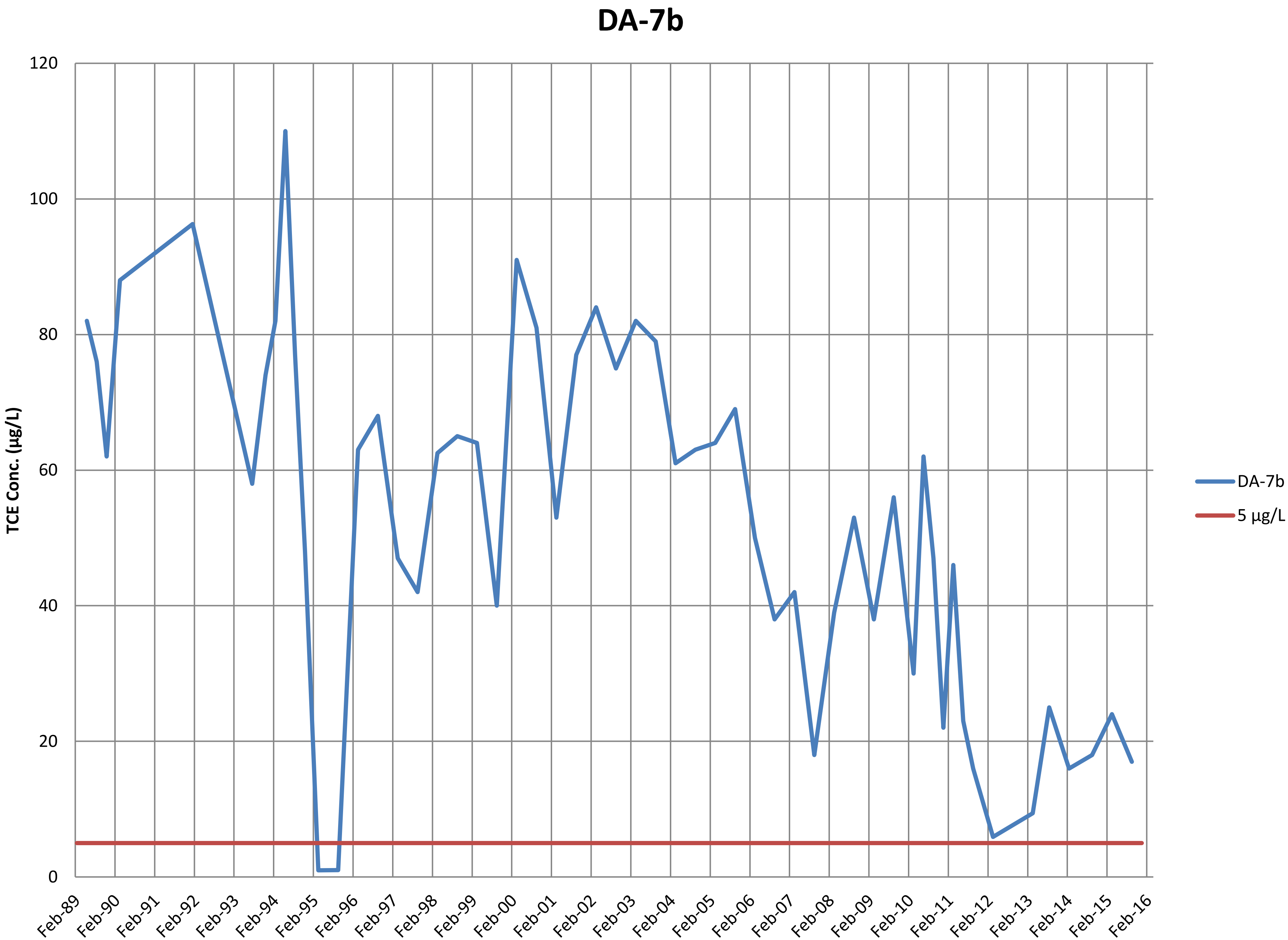
Graph 6. Average Annual TCE Concentration in Extraction Well DX-3
TCE Conc. (µg/L)
25.0
20.0
15.0
10.0
5.0
0.0
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
DX-3
5 µg/L

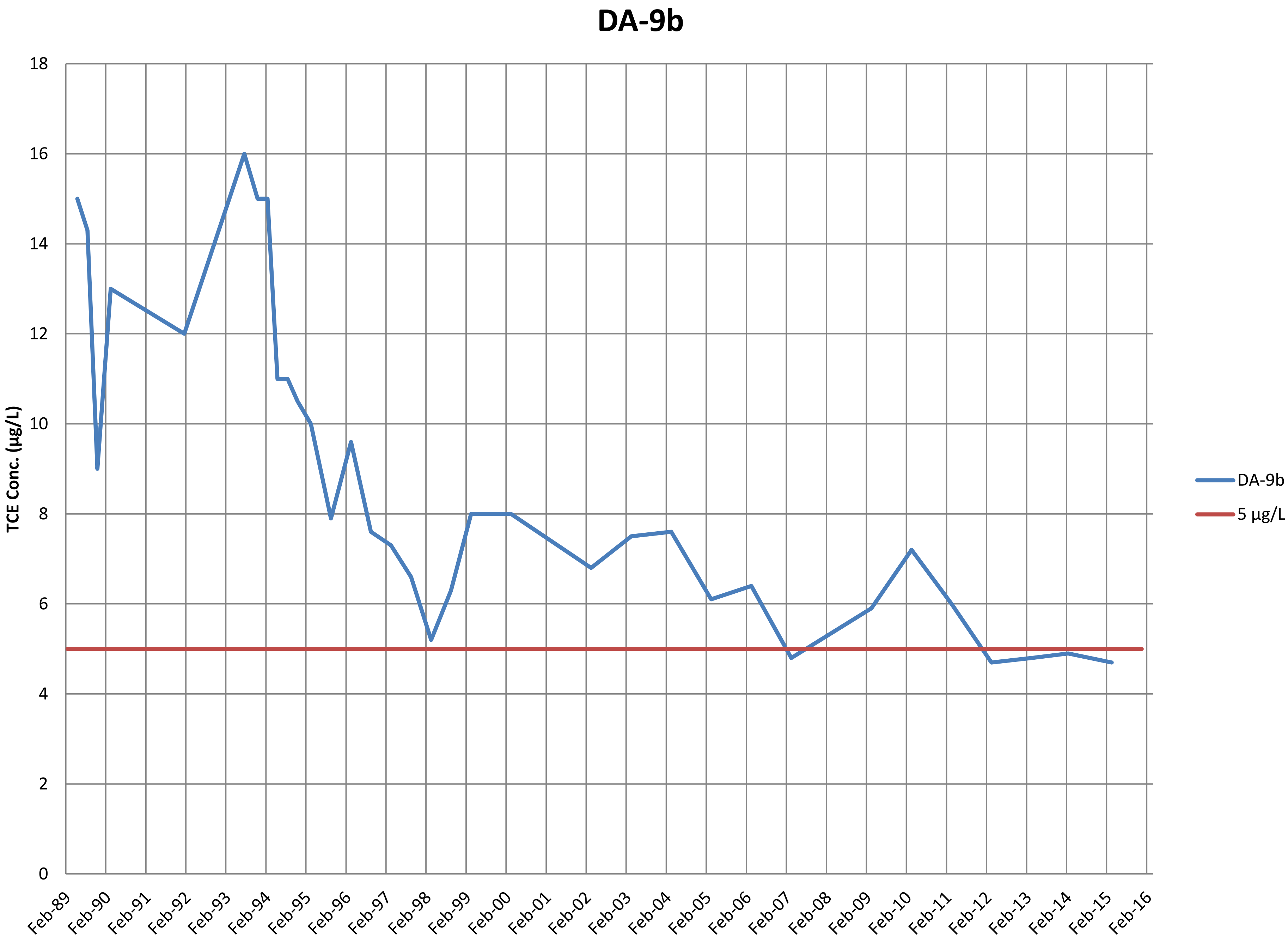
APPENDIX C

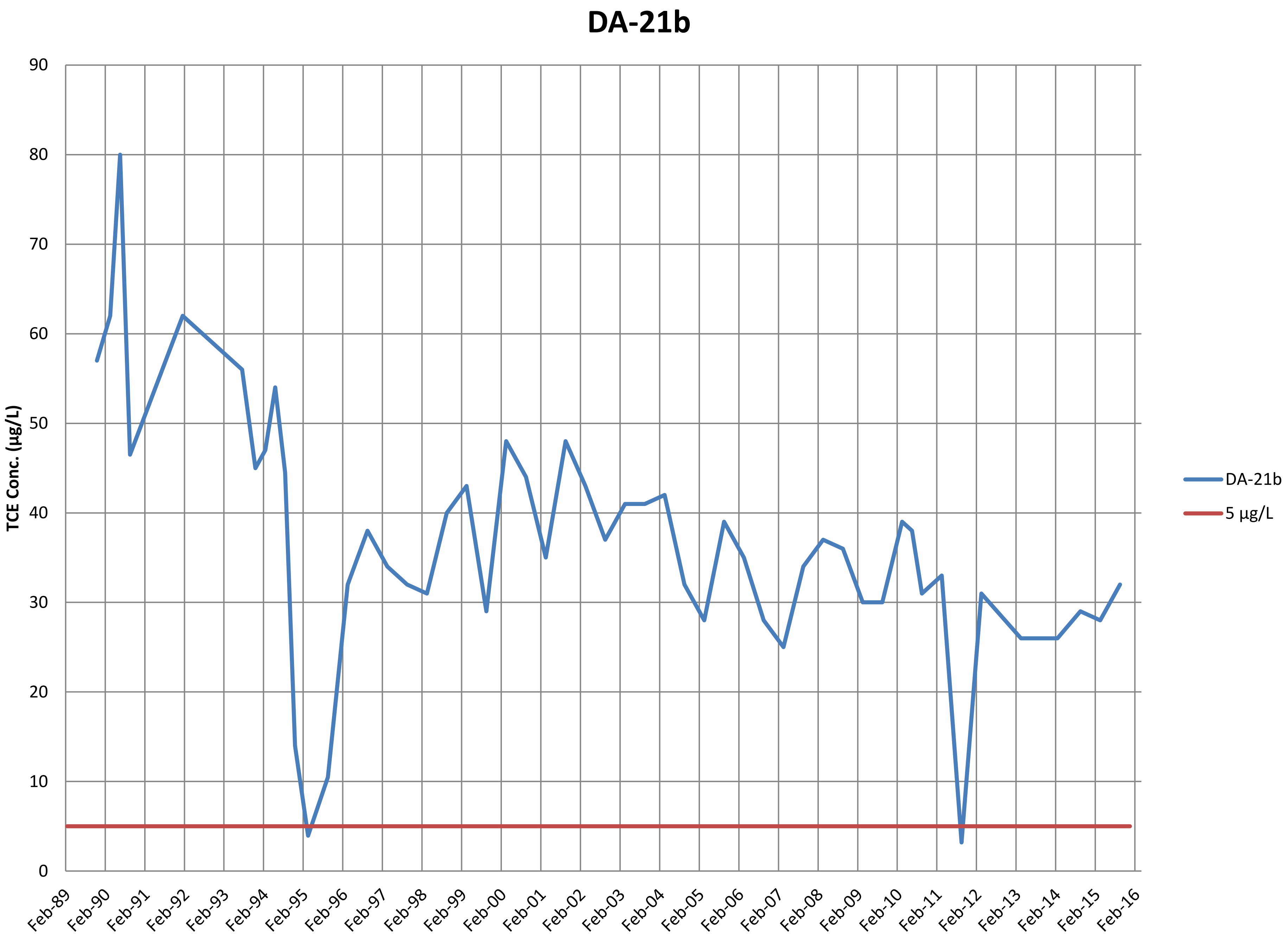
TCE CONCENTRATION PLOTS

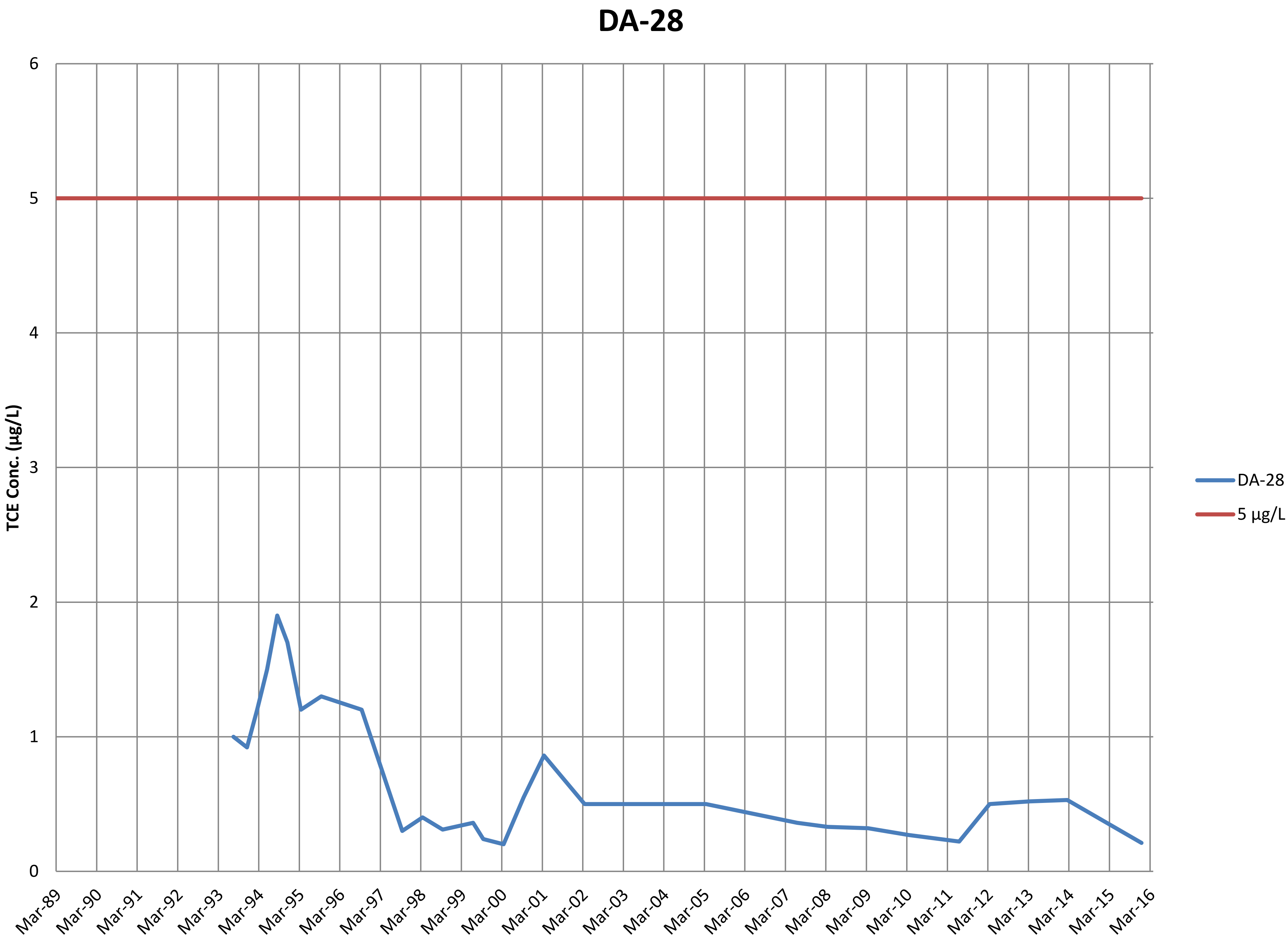
Plots of TCE Concentration Trends in Resource Protection Wells - 1989 through 2015

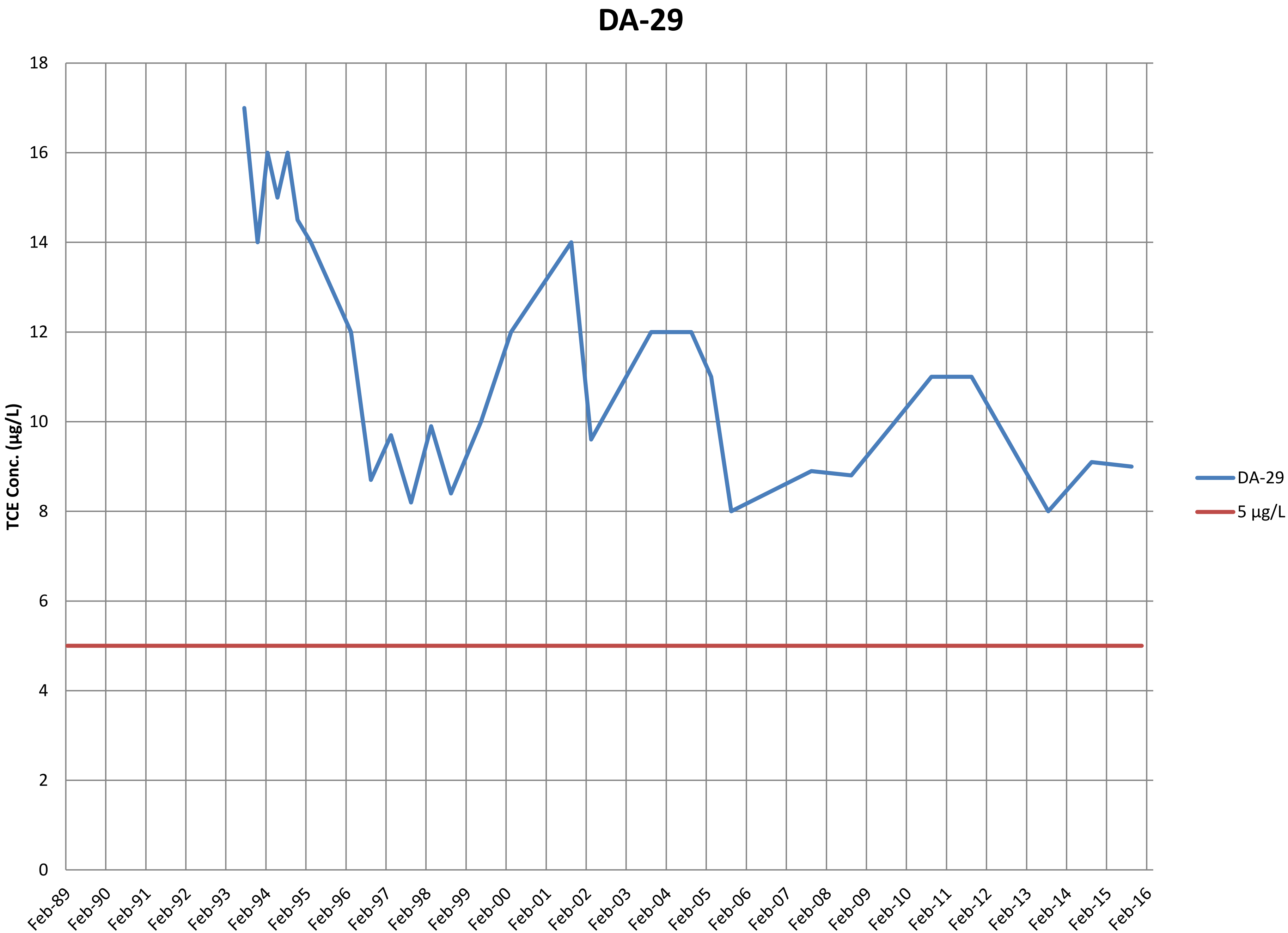
ALGT, JBLM McChord Field

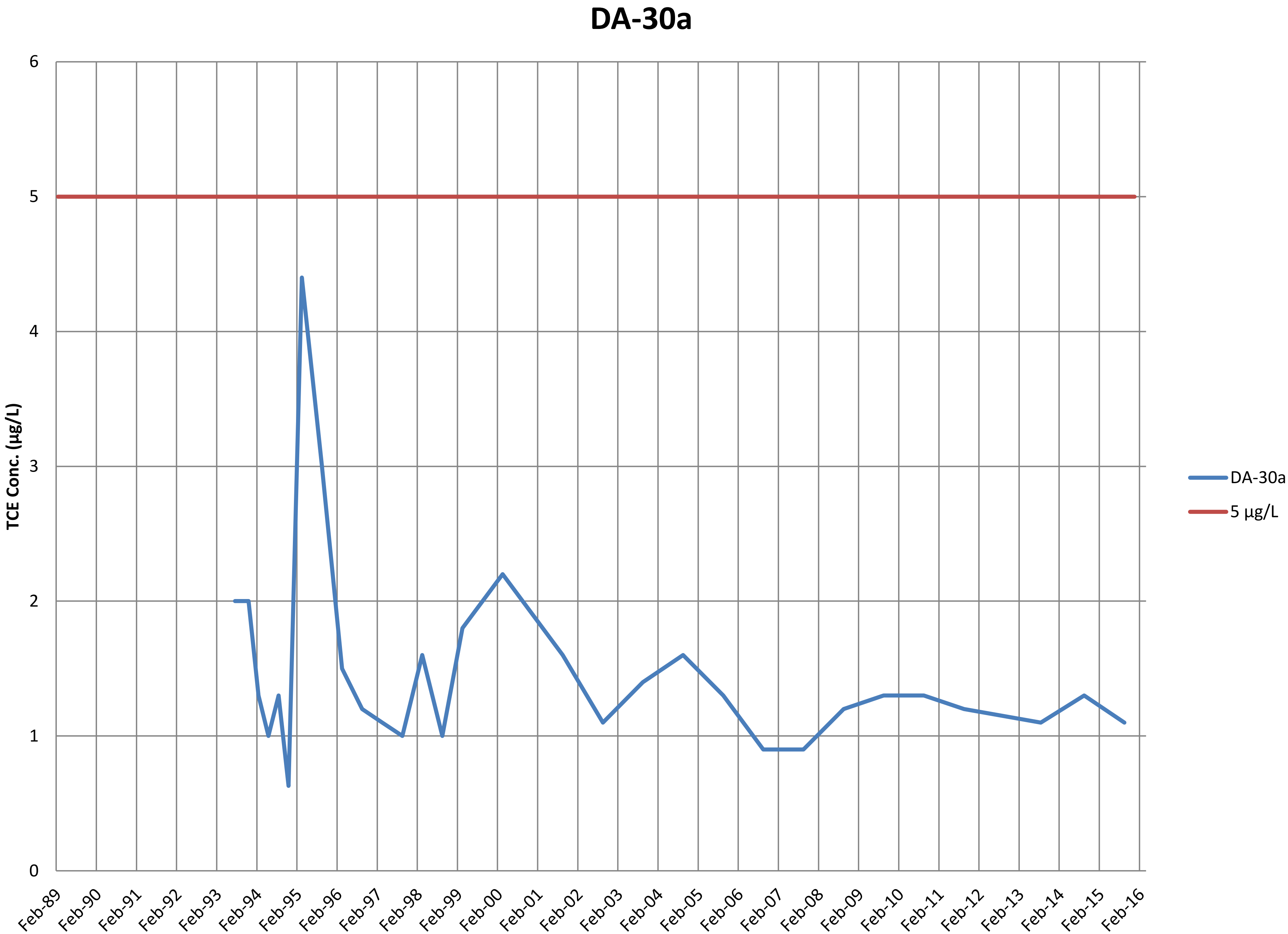


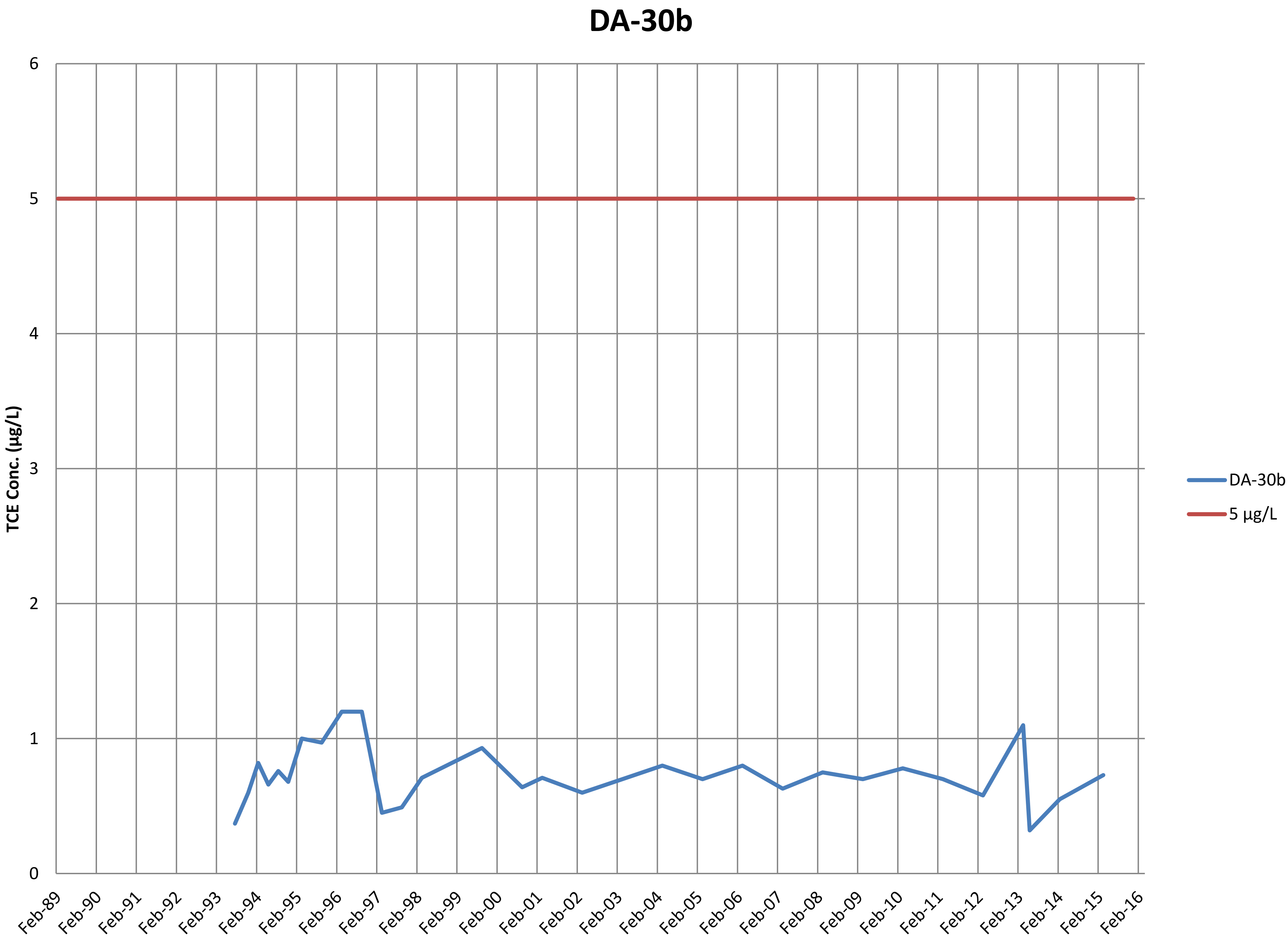

DA-9b
TCE Conc. (µg/L)
0
2
4
6
8
10
12
14
16
18
Feb-89
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14
Feb-15
Feb-16
DA-9b
5 µg/L

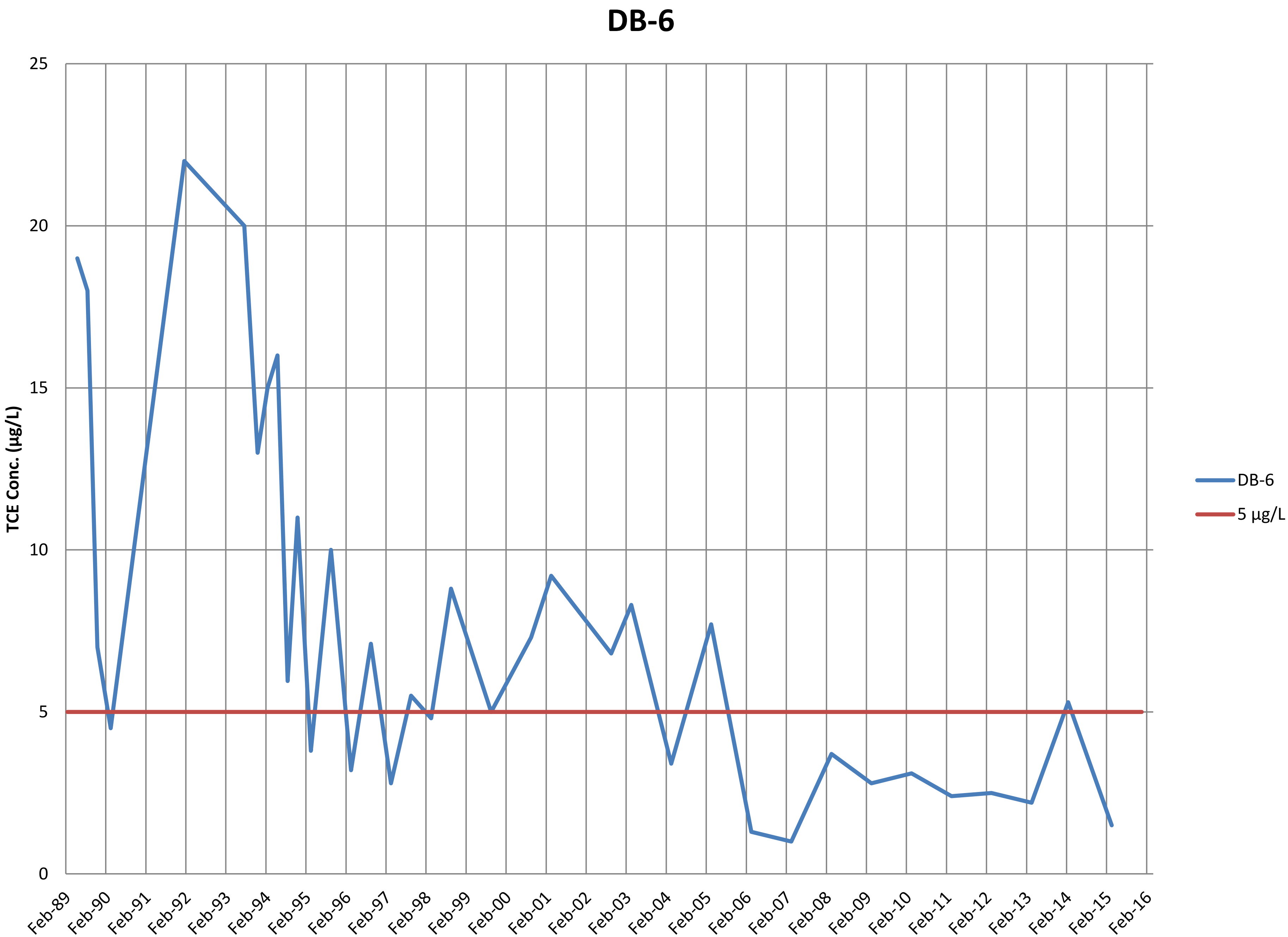

DA-21b
TCE Conc. (µg/L)
0
10
20
30
40
50
60
70
80
90
Feb-89
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14
Feb-15
Feb-16
DA-21b
5 µg/L

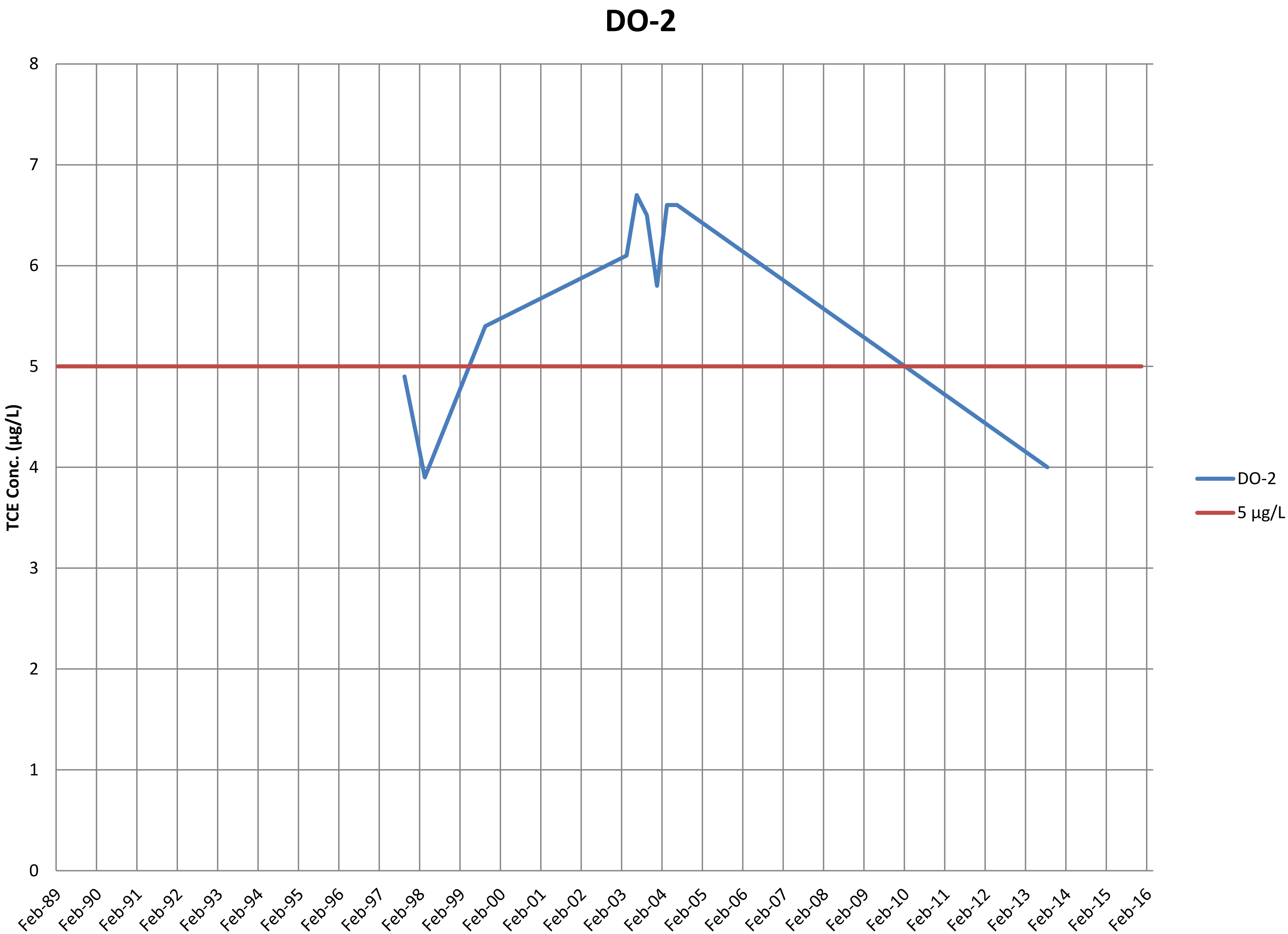

DA-28
TCE Conc. (µg/L)
6
5
4
3
2
1
0
Mar-89
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Mar-15
Mar-16
DA-28
5 µg/L


DA-29
18
16
14
12
10
8
6
4
2
0
TCE Conc. (µg/L)
Feb-89
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14
Feb-15
Feb-16
DA-29
5 µg/L


DA-30a
TCE Conc. (µg/L)
0
1
2
3
4
5
6
Feb-89
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14
Feb-15
Feb-16
DA-30a
5 µg/L

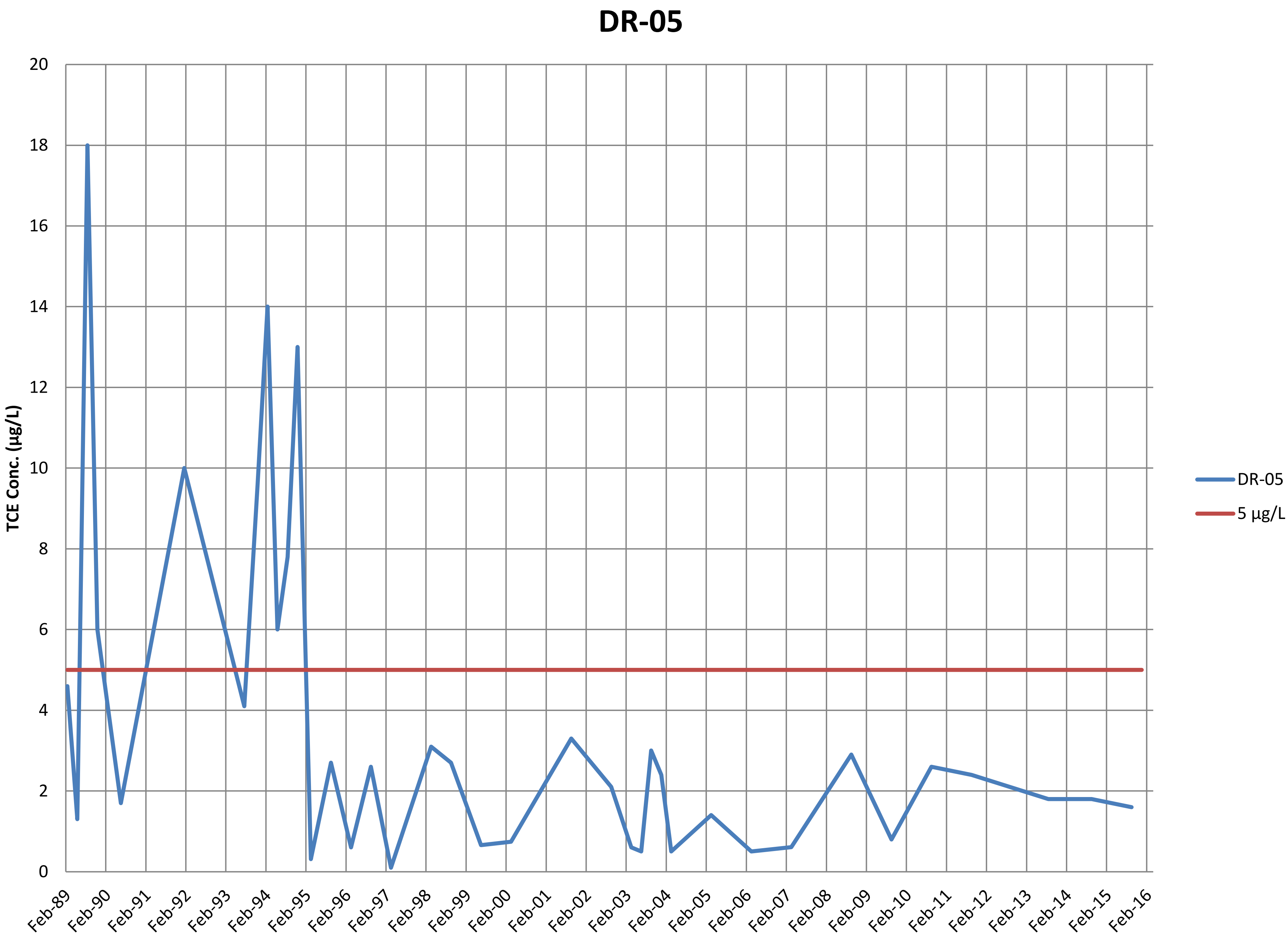

DA-30b
TCE Conc. (µg/L)
0
1
2
3
4
5
6
Feb-89
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14
Feb-15
Feb-16
DA-30b
5 µg/L

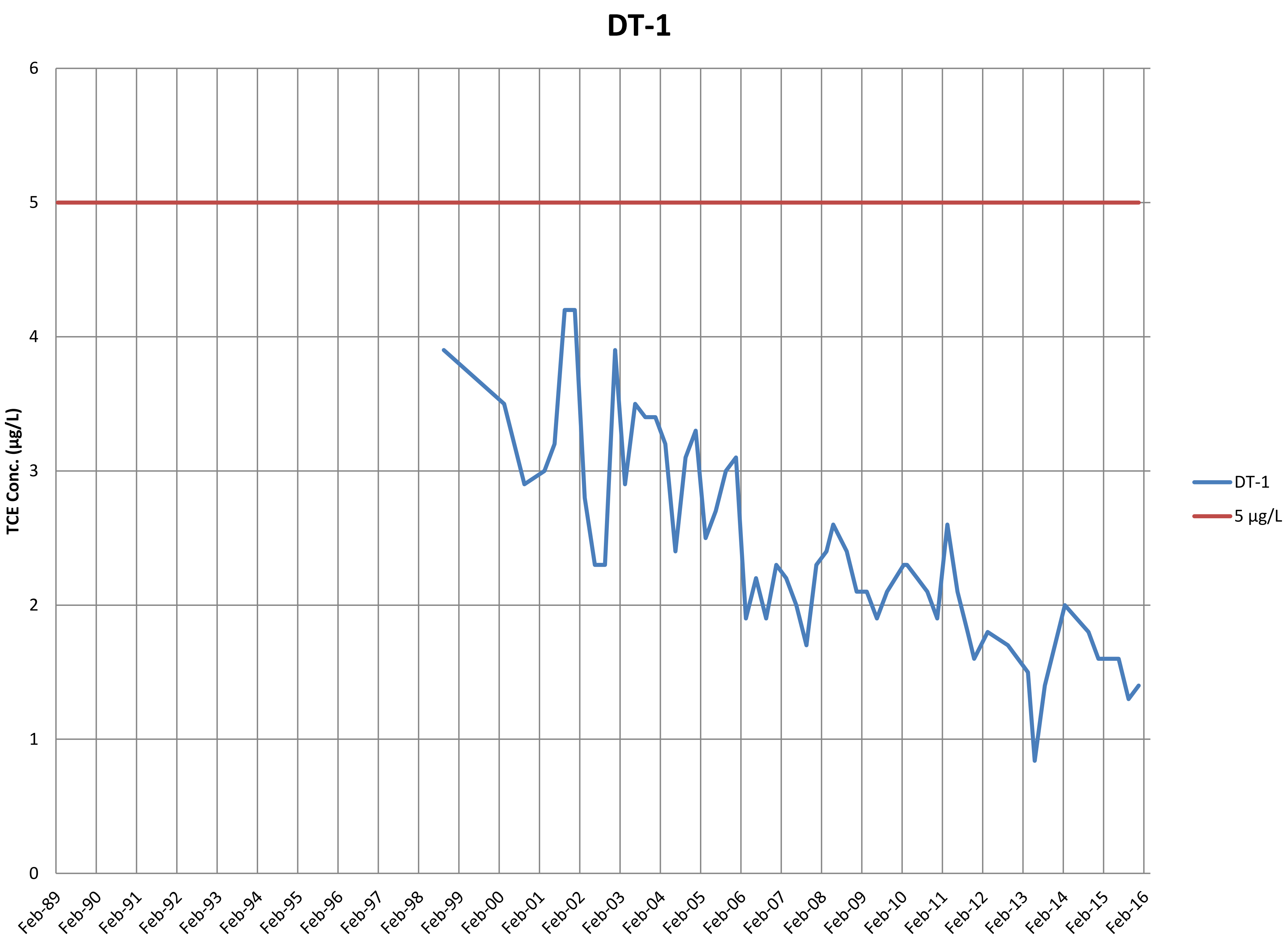

DB-6
TCE Conc. (µg/L)
25
20
15
10
5
0
Feb-89
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14
Feb-15
Feb-16
DB-6
5 µg/L

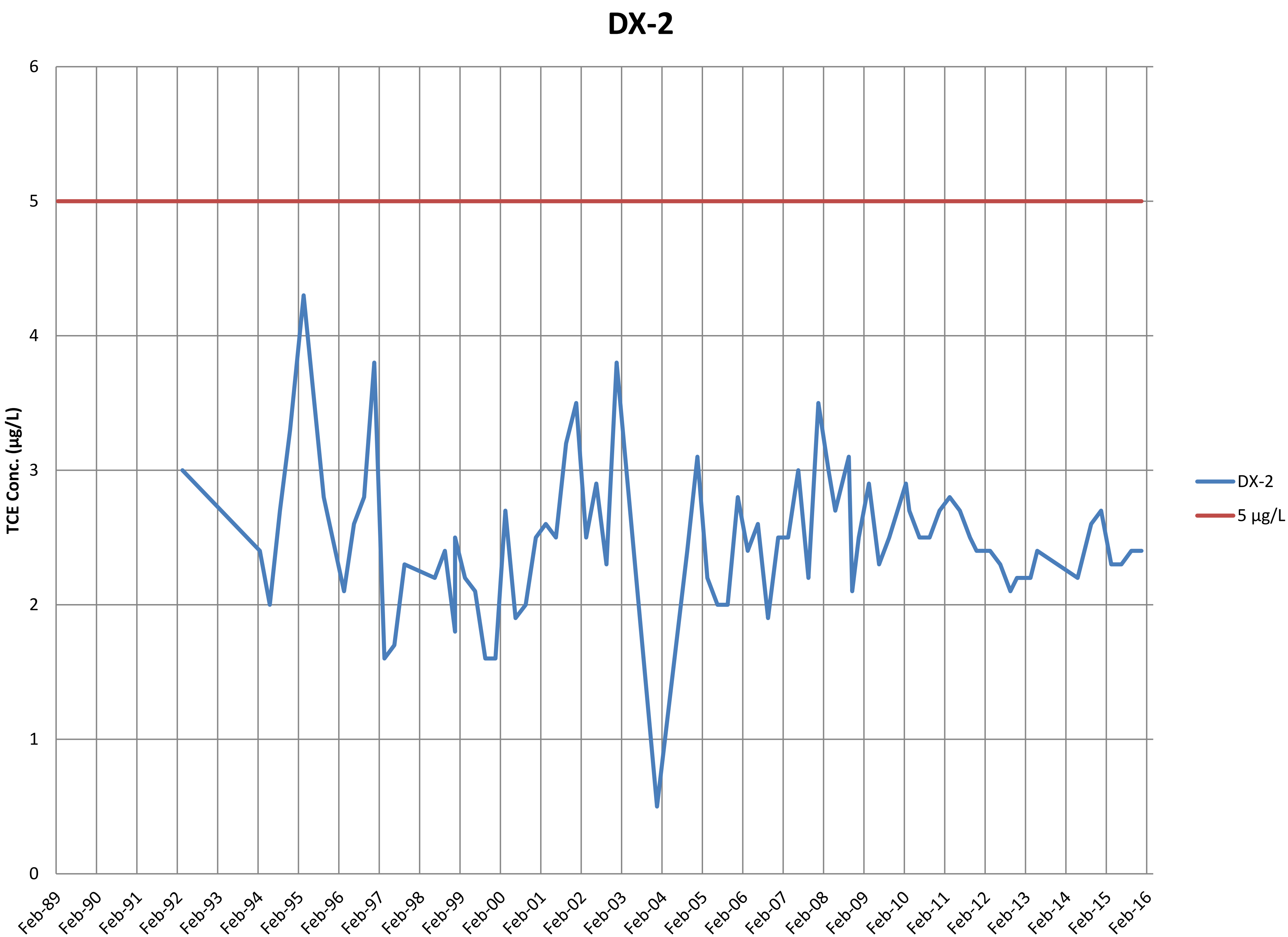

DO-2
TCE Conc. (µg/L)
0
1
2
3
4
5
6
7
8
Feb-89
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14
Feb-15
Feb-16
DO-2
5 µg/L

Plots of TCE Concentration Trends in Resource Protection Wells - 1989 through 2015

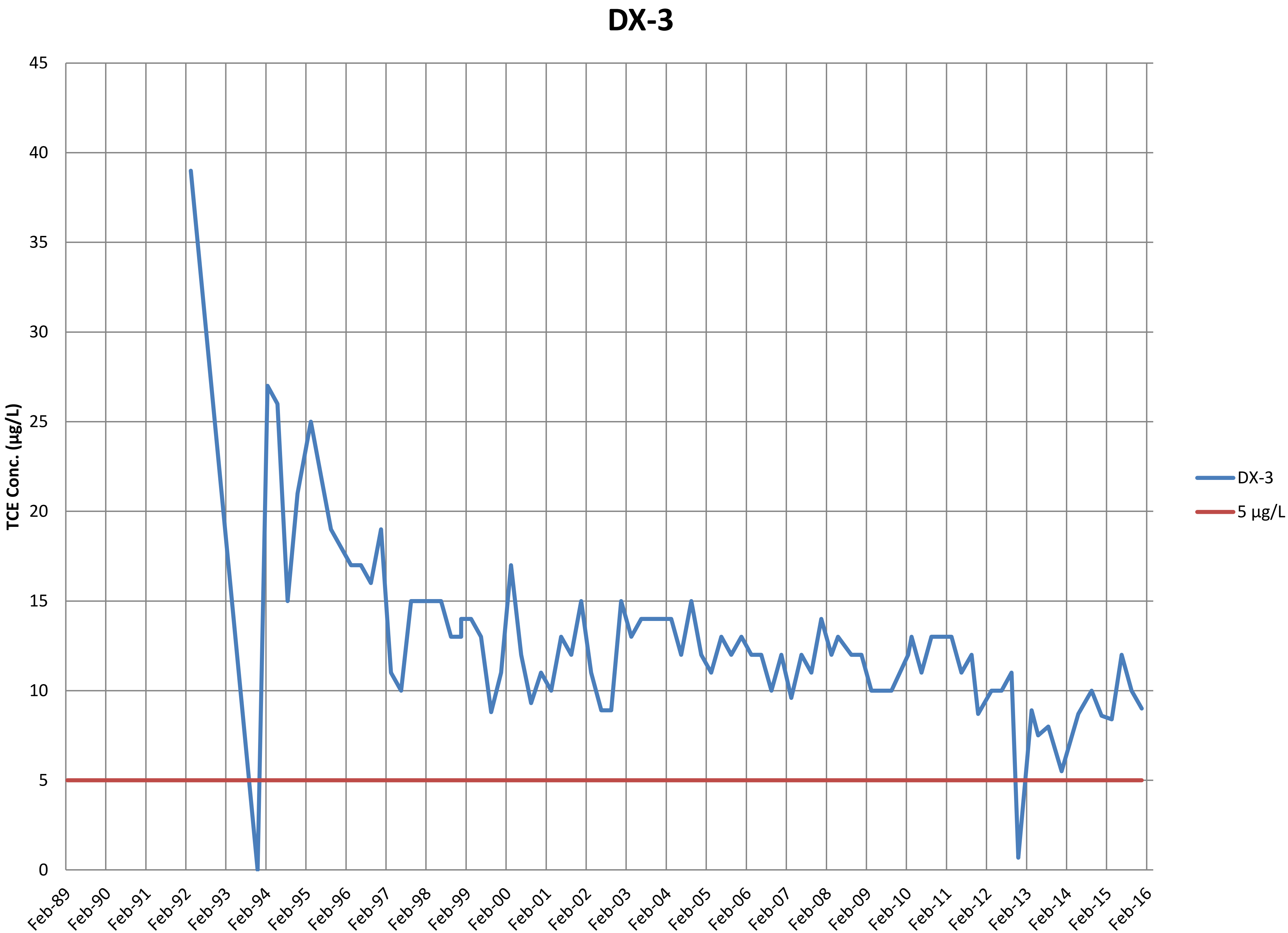
ALGT, JBLM McChord Field

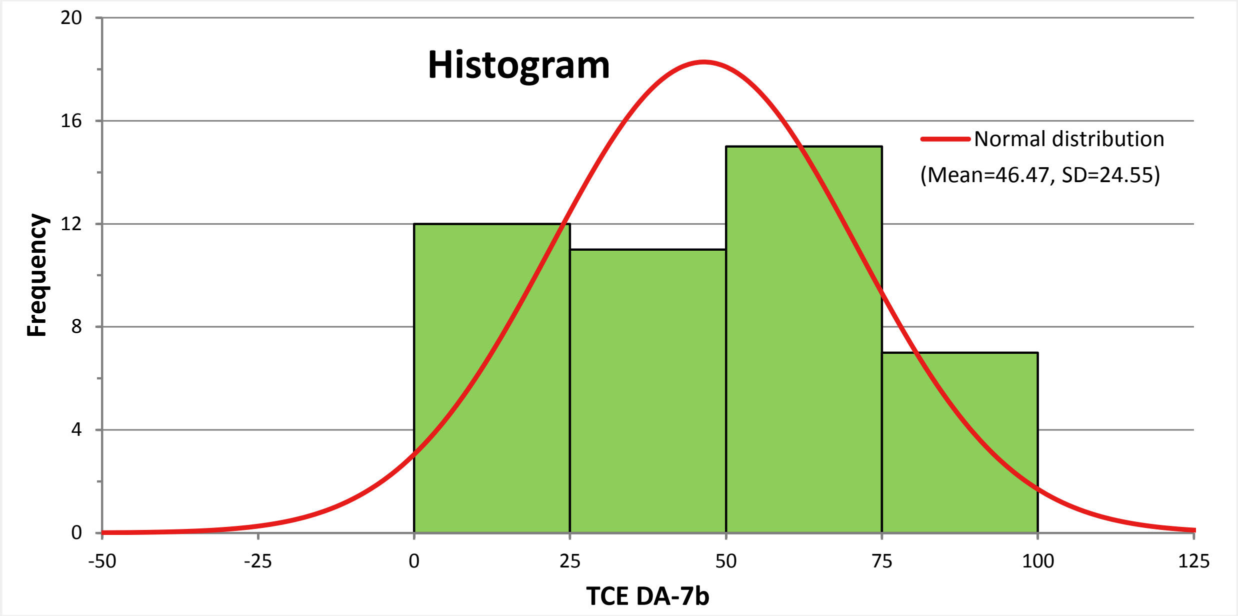


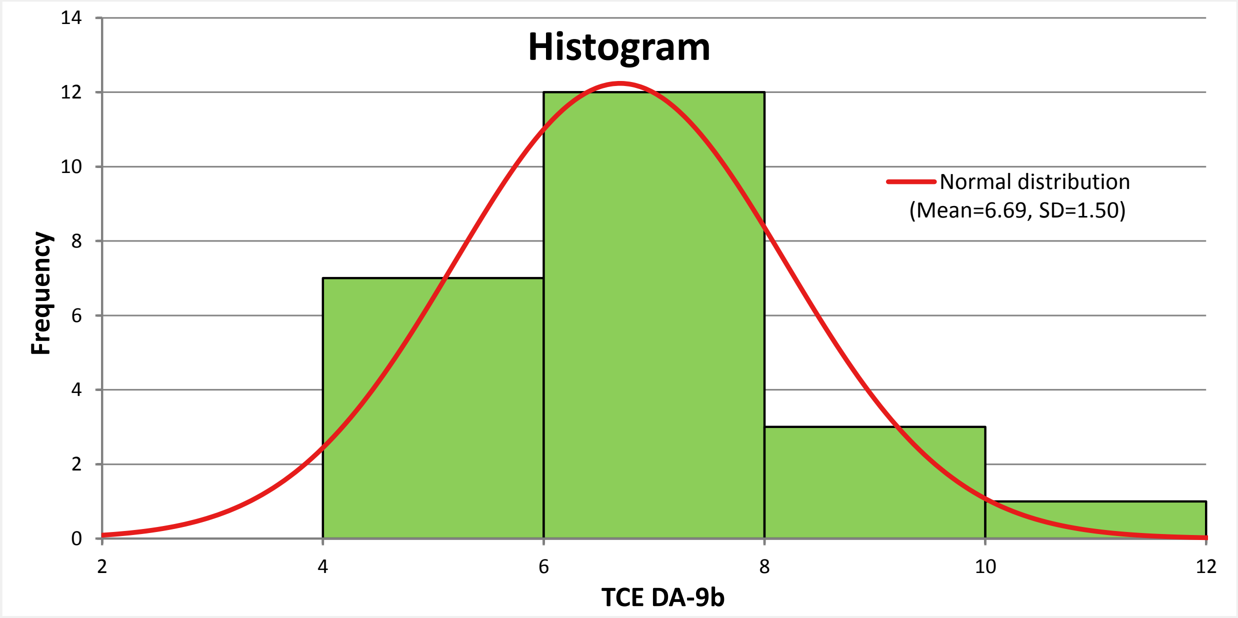

DT-1
TCE Conc. (µg/L)
0
1
2
3
4
5
6
Feb-89
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14
Feb-15
Feb-16
DT-1
5 µg/L

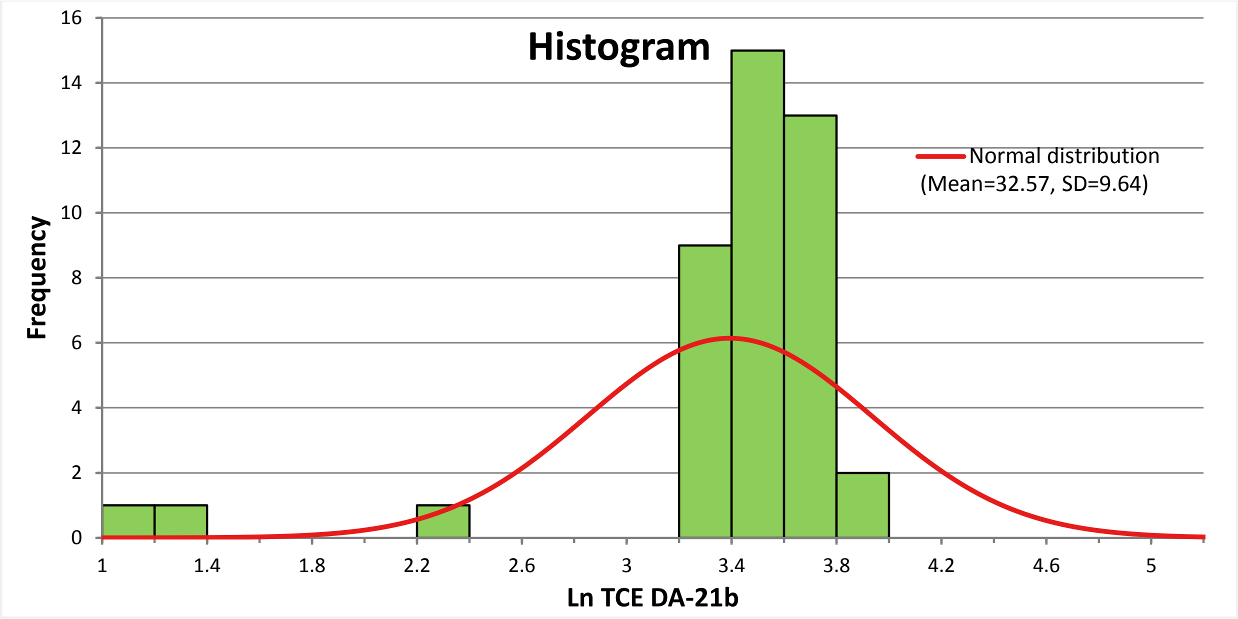

DX-2
TCE Conc. (µg/L)
0
1
2
3
4
5
6
Feb-89
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11
Feb-12
Feb-13
Feb-14
Feb-15
Feb-16
DX-2
5 µg/L

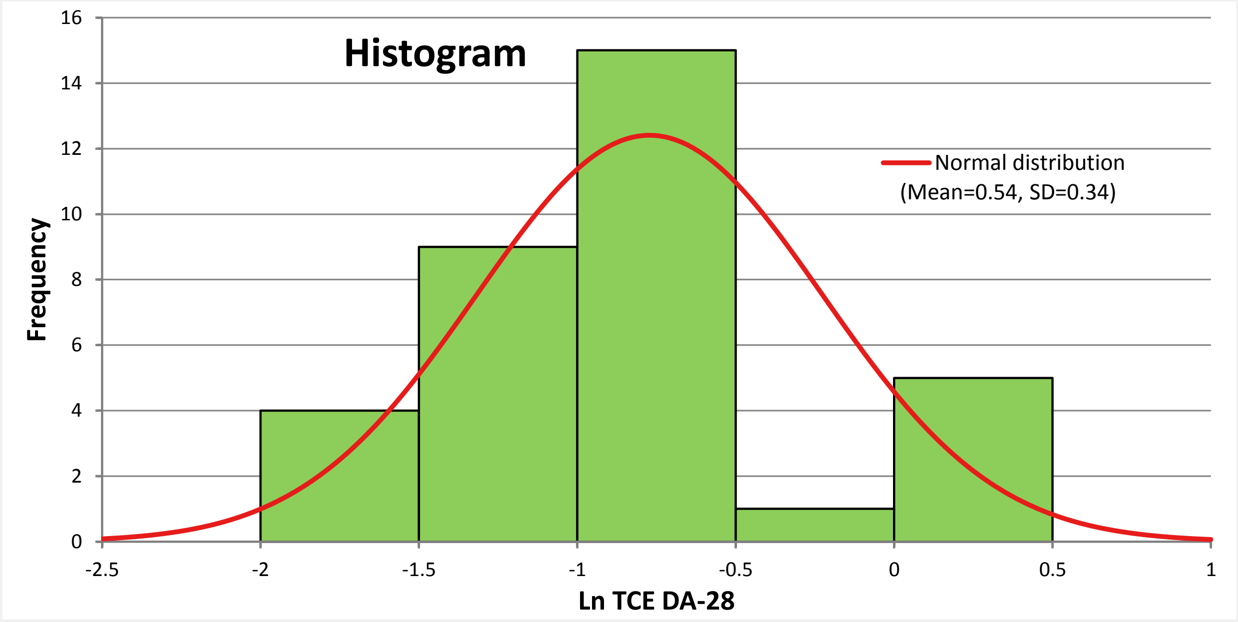
Plots of TCE Concentration Trends in Resource Protection Wells - 1989 through 2015
ALGT, JBLM McChord Field

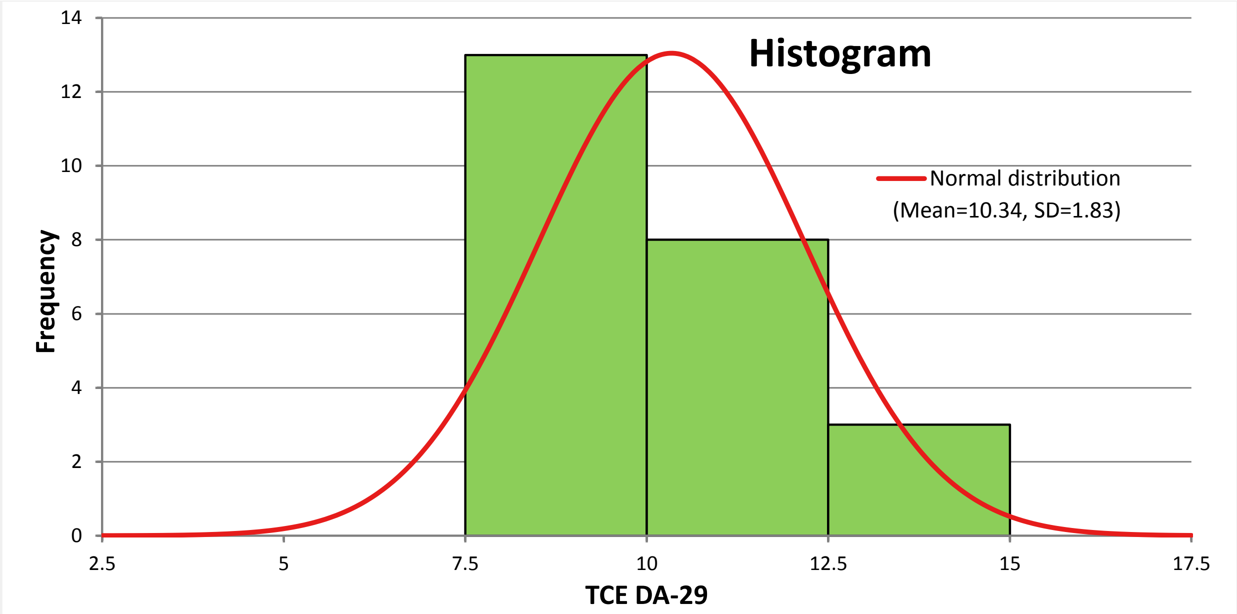


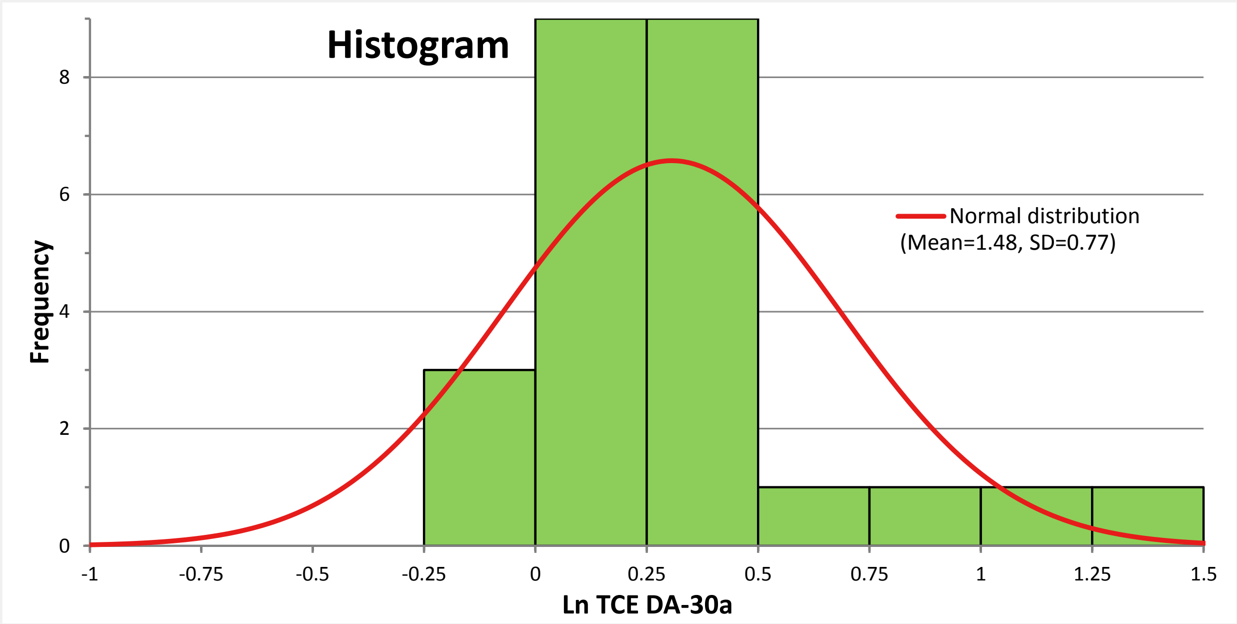

Histogram
Frequency
20
16
12
8
4
0
-50
-25
0
25
50
75
100
125
TCE DA-7b
Normal distribution
(Mean=46.47, SD=24.55)

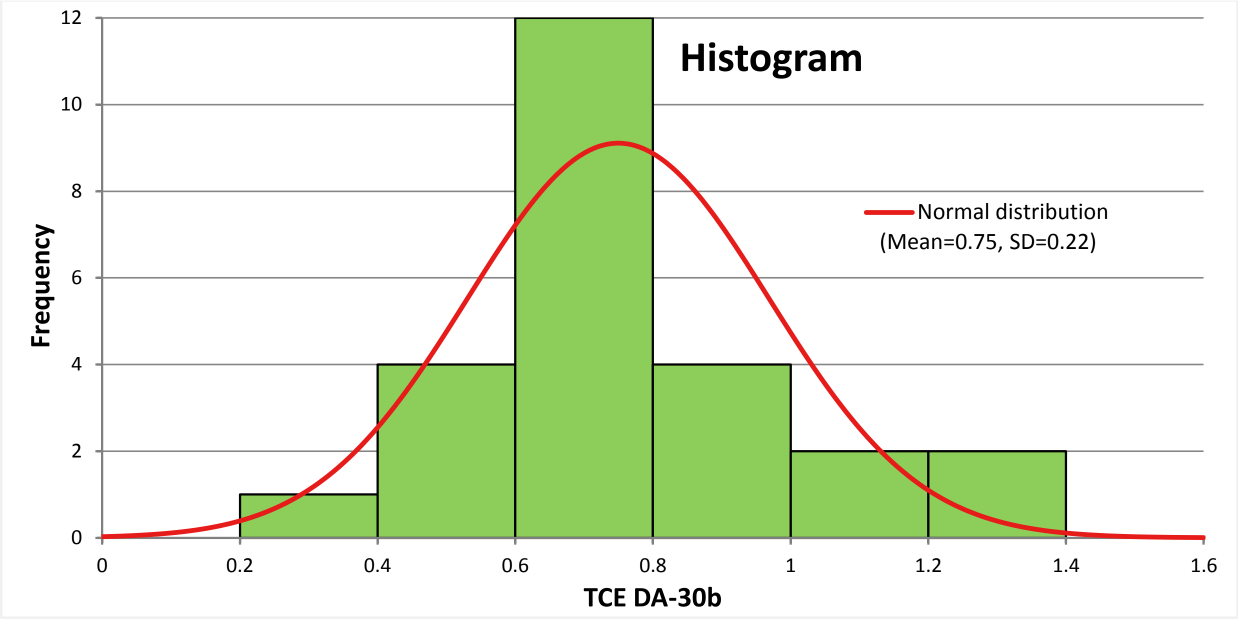

Histogram
Frequency
14
12
10
8
6
4
2
0
2
4
6
8
10
12
TCE DA-9b
Normal distribution
(Mean=6.69, SD=1.50)

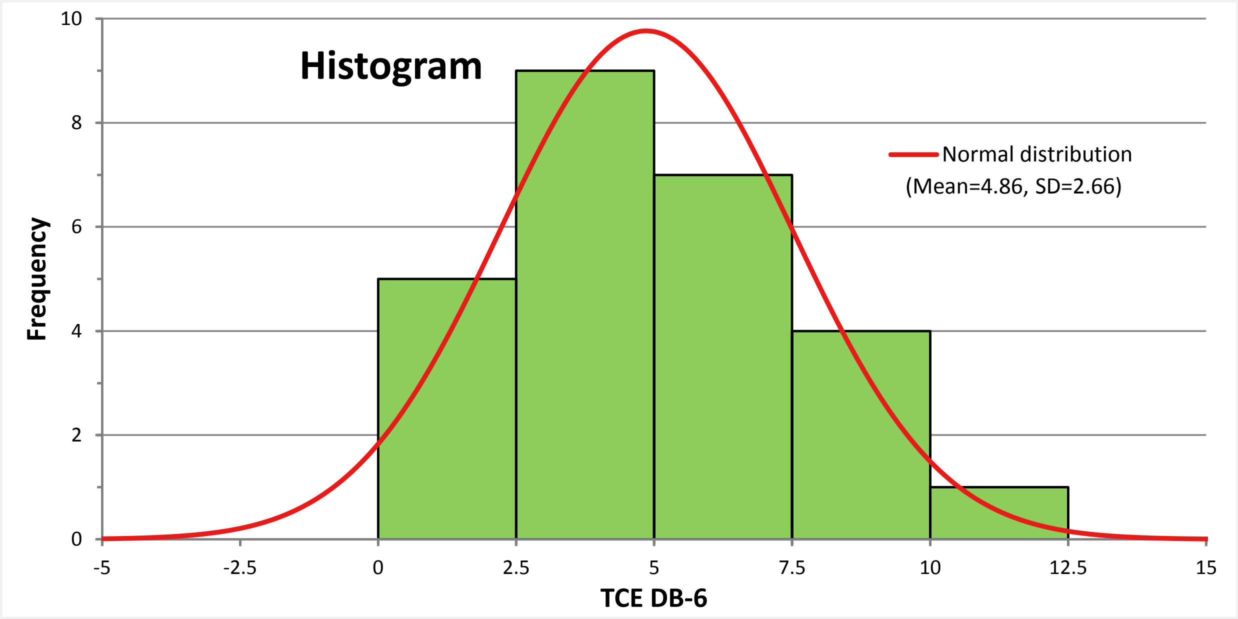

Histogram
Frequency
16
14
12
10
8
6
4
2
0
1
1.4
1.8
2.2
2.6
3
3.4
3.8
4.2
4.6
5
Normal distribution
(Mean=32.57, SD=9.64)
Ln TCE DA-21b

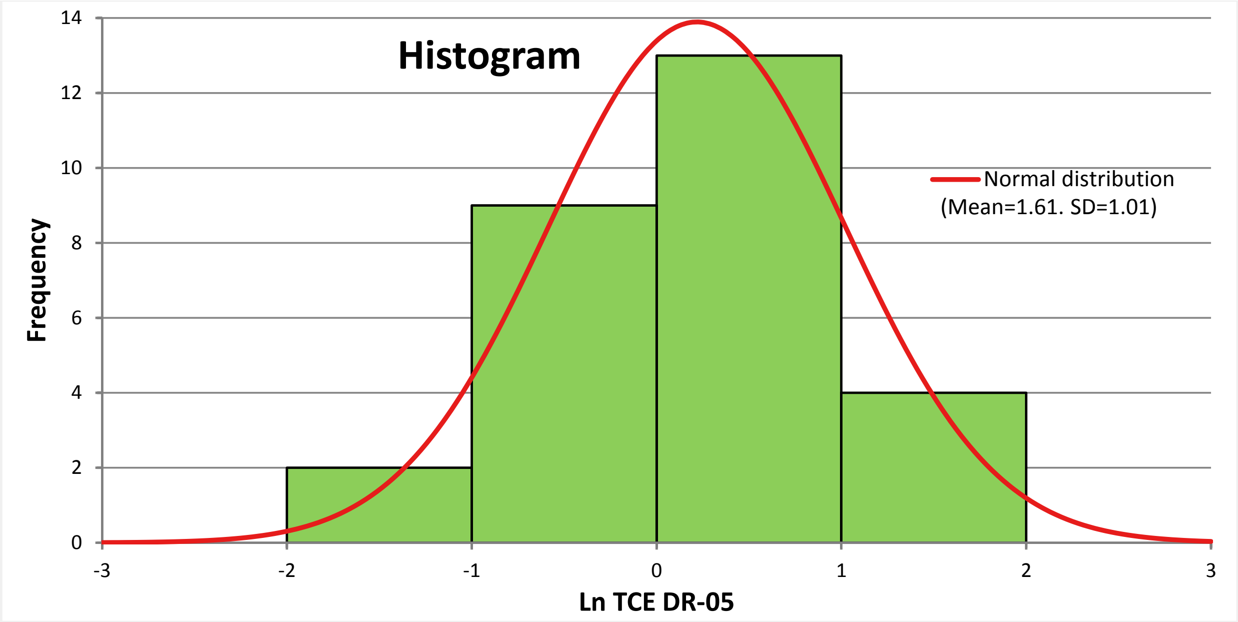

Histogram
Frequency
16
14
12
10
8
6
4
2
0
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
Normal distribution
(Mean=0.54, SD=0.34)
Ln TCE DA-28


Histogram
Frequency
14
12
10
8
6
4
2
0
2.5
5
7.5
10
12.5
15
17.5
TCE DA-29
Normal distribution
(Mean=10.34, SD=1.83)

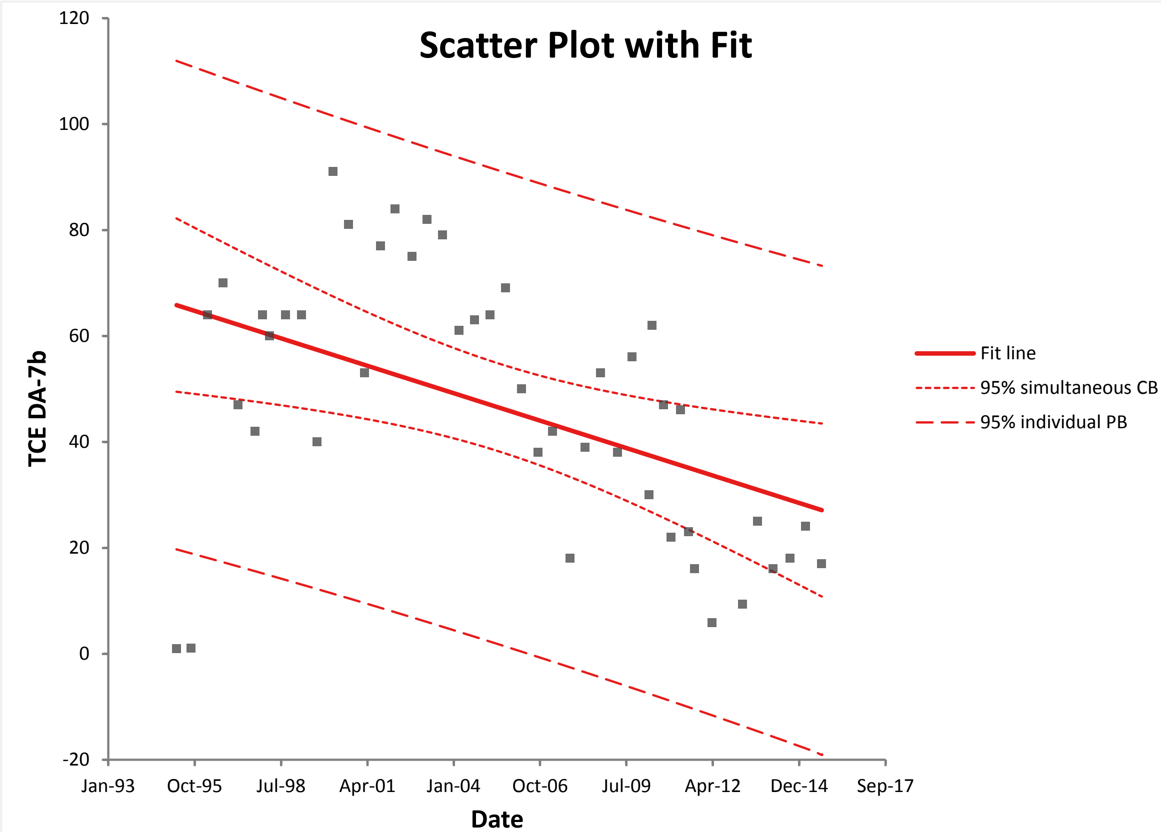

Histogram
Frequency
8
6
4
2
0
-1
-0.75
-0.5
-0.25
0
0.25
0.5
0.75
1
1.25
1.5
Ln TCE DA-30a
Normal distribution
(Mean=1.48, SD=0.77)

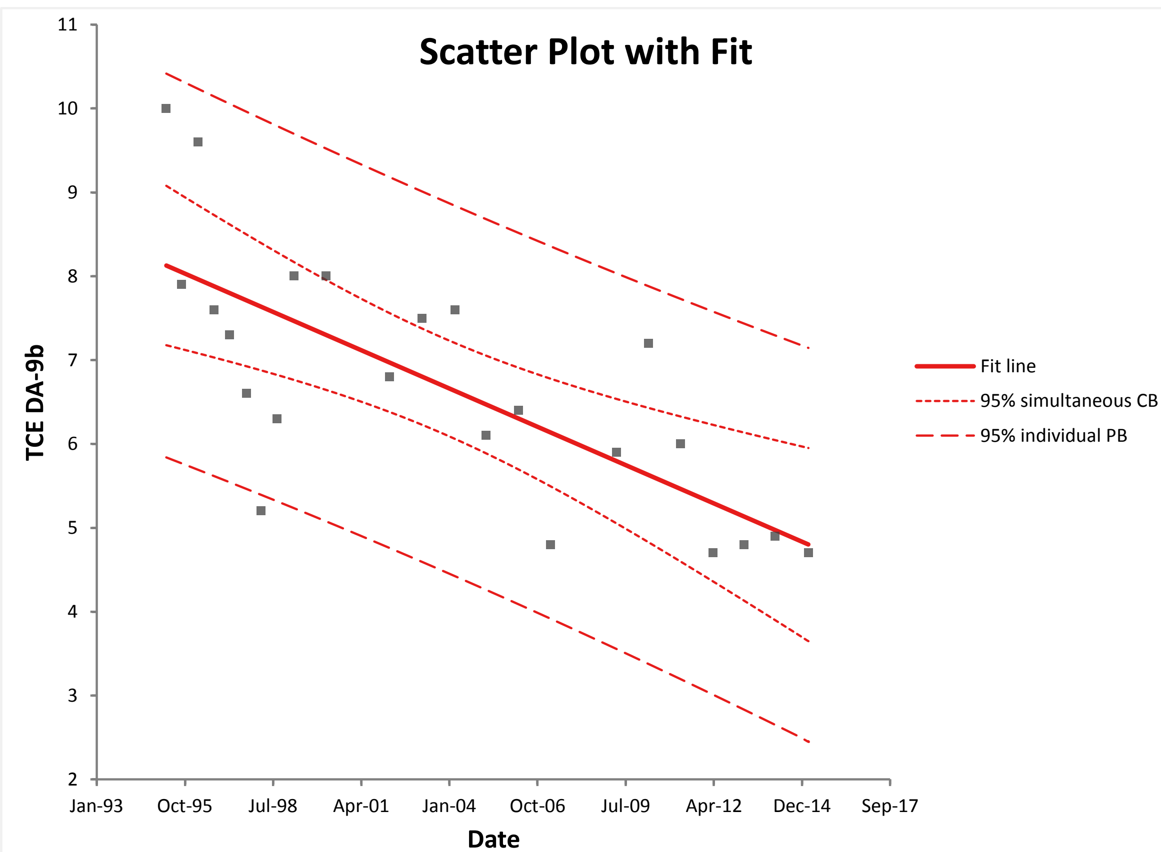

Histogram
Normal distribution
(Mean=0.75, SD=0.22)
Frequency
12
10
8
6
4
2
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
TCE DA-30b

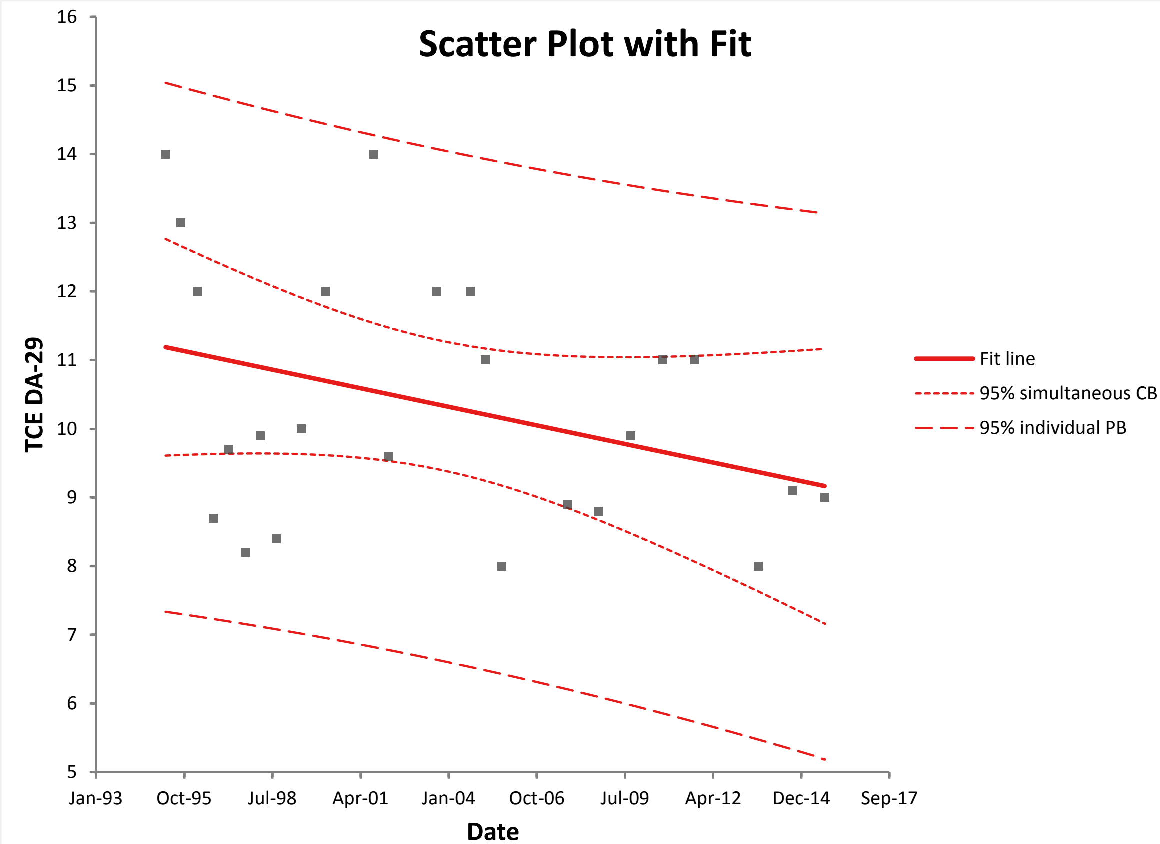

Histogram
Normal distribution
(Mean=4.86, SD=2.66)
Frequency
10
8
6
4
2
0
-5
-2.5
0
2.5
5
7.5
10
12.5
15
TCE DB-6

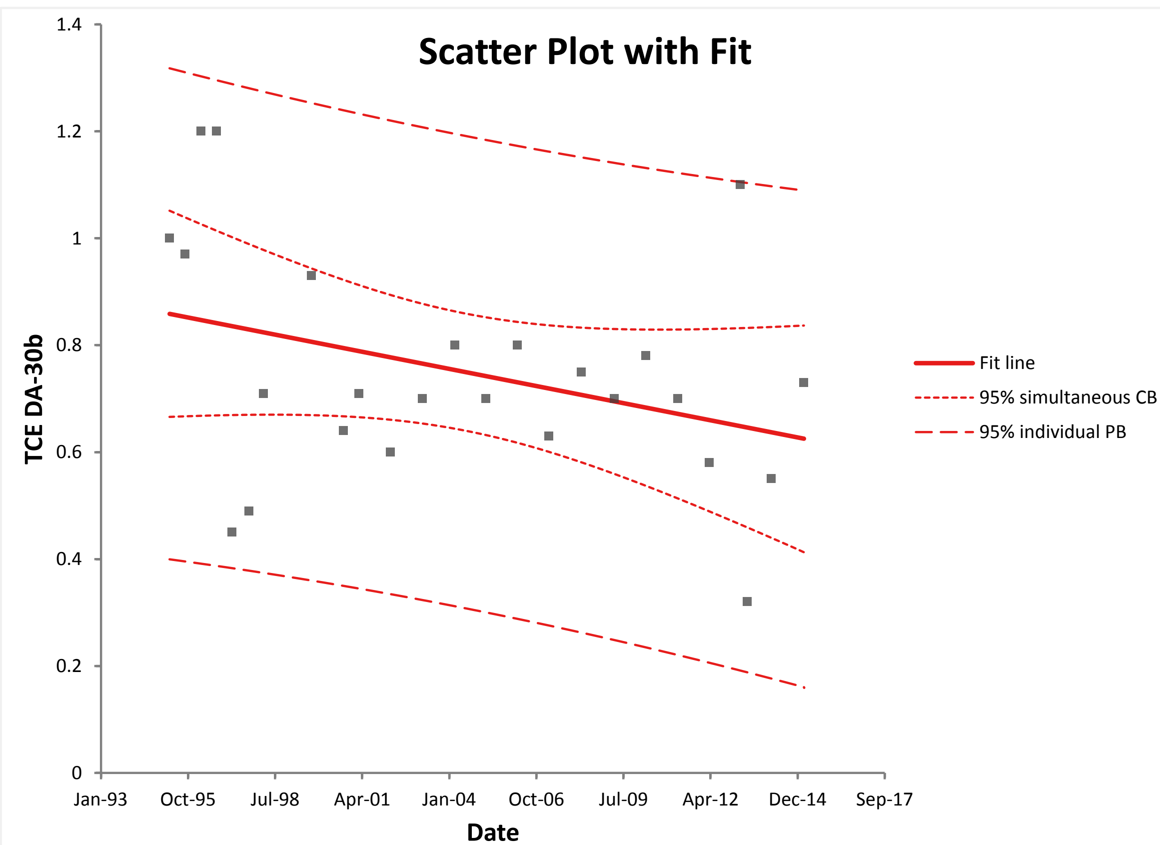

Histogram
Frequency
14
12
10
8
6
4
2
0
-3
-2
-1
0
1
2
3
Ln TCE DR-05
Normal distribution
(Mean=1.61. SD=1.01)

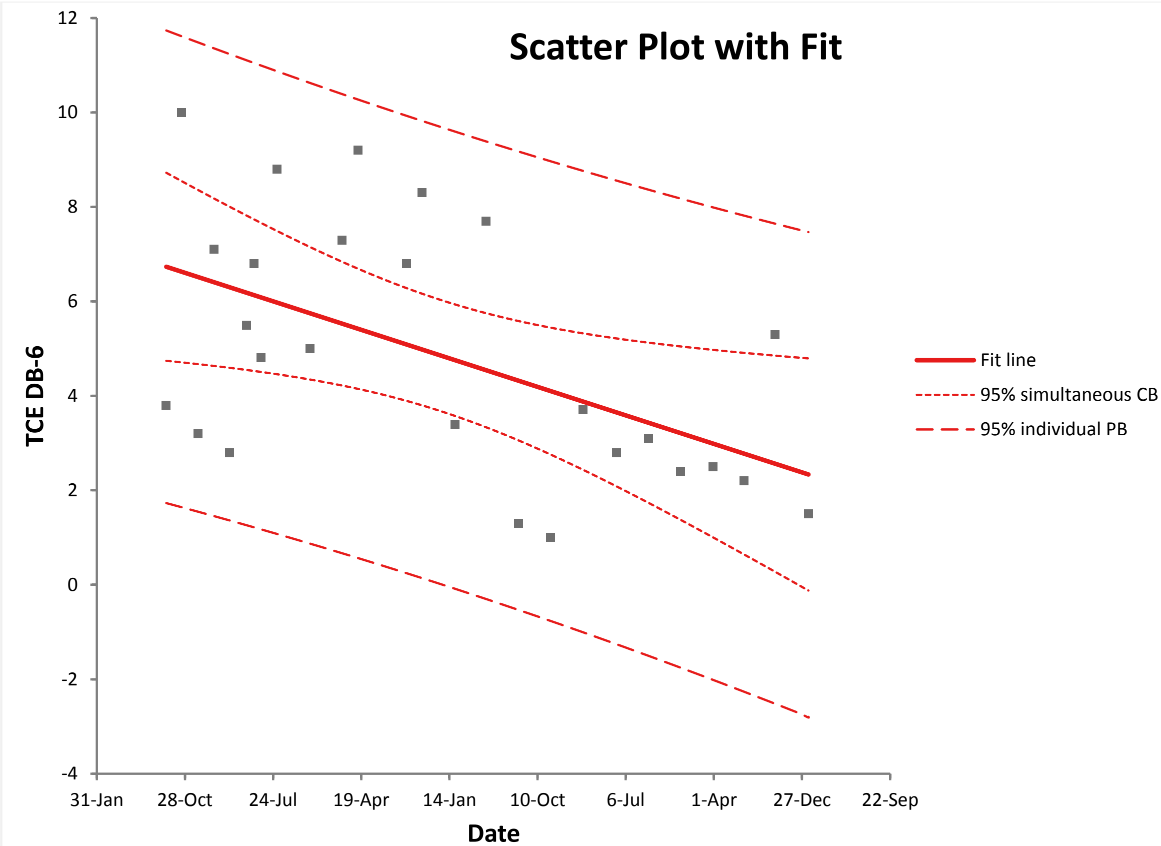
Statistics Figures
Linear Regression Graphs
ALGT, JBLM McChord Field

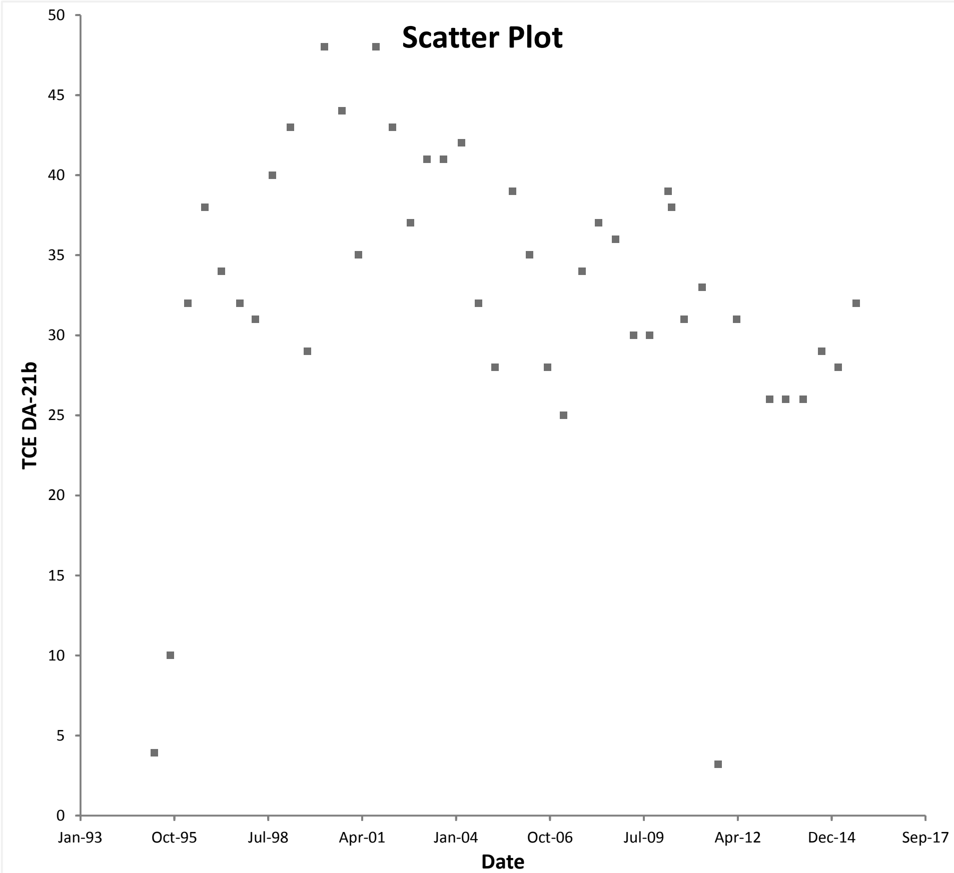


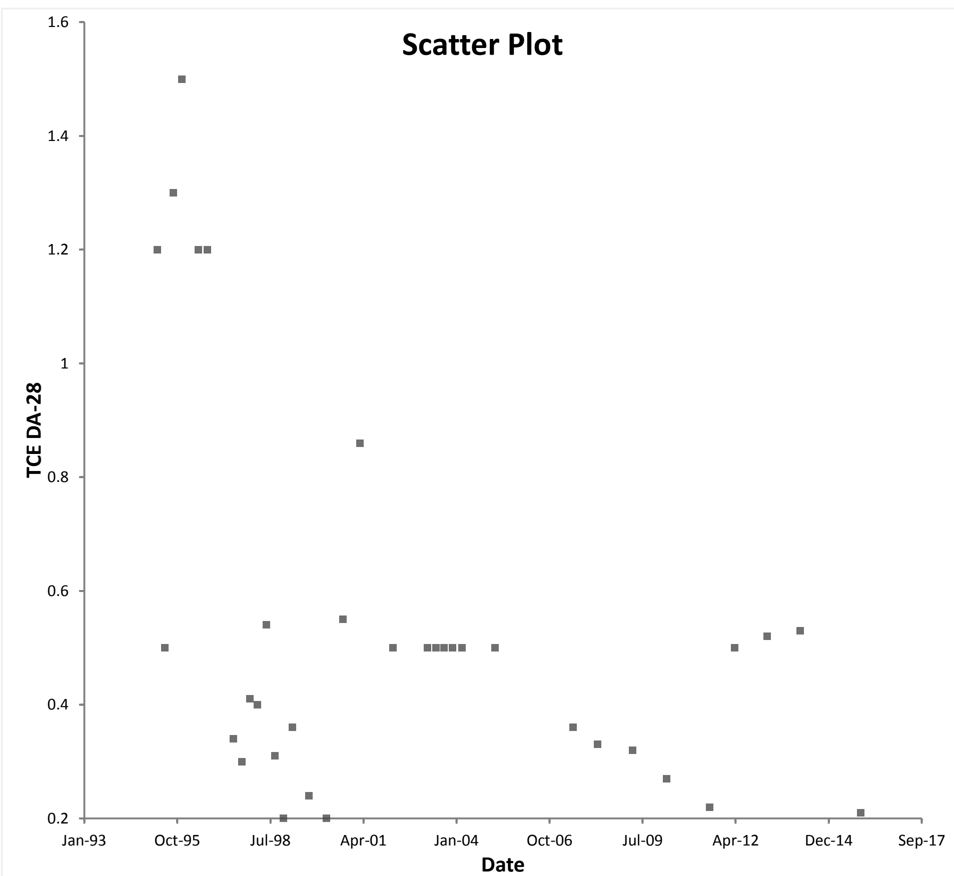


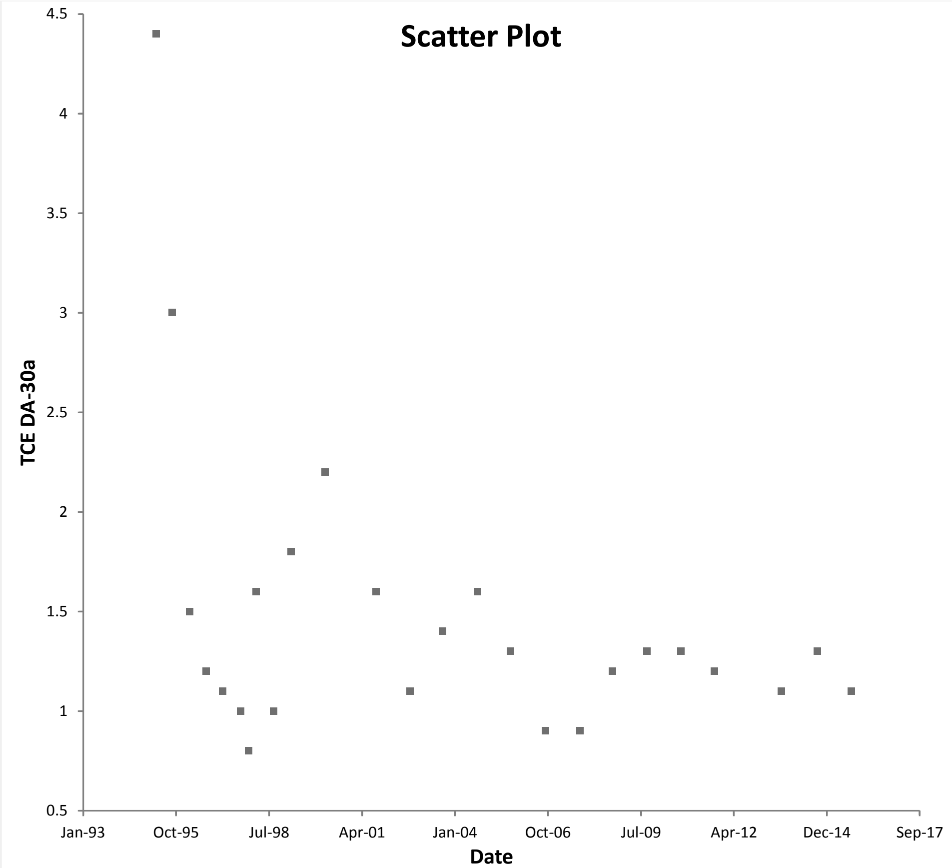

Scatter Plot with Fit
16
15
14
13
12
11
10
9
8
7
6
5
TCE DA-29
Jan-93
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Date
Fit line
95% simultaneous CB
95% individual PB

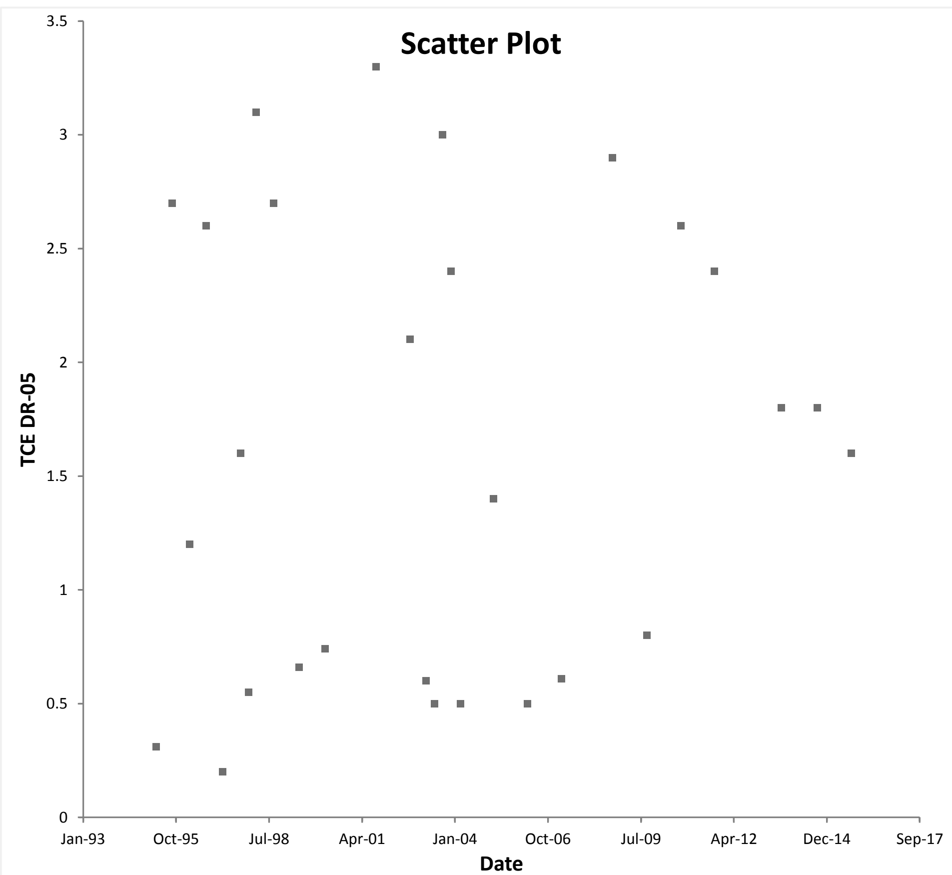

Scatter Plot with Fit
1.4
1.2
1
0.8
0.6
0.4
0.2
0
TCE DA-30b
Jan-93
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Date
Fit line
95% simultaneous CB
95% individual PB


Scatter Plot with Fit
TCE DB-6
12
10
8
6
4
2
0
-2
-4
31-Jan
28-Oct
24-Jul
19-Apr
14-Jan
10-Oct
6-Jul
1-Apr
27-Dec
22-Sep
Date
Fit line
95% simultaneous CB
95% individual PB


Scatter Plot
TCE DA-21b
0
5
10
15
20
25
30
35
40
45
50
Jan-93
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Date


Scatter Plot
TCE DA-28
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Jan-93
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Date


Scatter Plot
TCE DA-30a
4.5
4
3.5
3
2.5
2
1.5
1
0.5
Jan-93
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Date


Scatter Plot
TCE DR-05
3.5
3
2.5
2
1.5
1
0.5
0
Jan-93
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Date

Appendix 5

Evaluation of Human Health and Ecological Risk Assumptions (Changes in Risk Assessment Methods, Exposure Assumptions, and Toxicity)

APPENDIX 5
Changes in Risk Assessment Methods, Exposure Assumptions, and Toxicity

The evaluation of whether changes in risk assessment methods, exposure assumptions, and toxicity values, as presented in previous sections, can call the protectiveness of the remedy into question is made somewhat difficult by the interplay of these factors in calculating risks. This question can be more easily addressed by using the Regional Screening Level (RSL) Calculator. The RSLs are To Be Considered (TBC) values that are based on calculating levels of chemicals that pose a cancer risk of 10^{-6} or a Hazard Quotient of 1. The RSL calculator uses the same basic equations that would be used in a current CERCLA Baseline Risk Assessment with the exposure factors representing the default factors that would be used unless site-specific conditions were identified that would modify intakes at a particular site, and the most current toxicity values from EPA or other approved sources would be used. Thus, the RSL calculator can be used to determine RSLs or to calculate the risks associated with the cleanup levels.

Table 3-1 in Appendix 1 of the Five Year Review (FYR) report shows the results of this calculation for constituents where the RSL is lower than the Site Cleanup Level (SCL). In these instances, the corresponding risk level is calculated and described below.

Logistics Center
For the COCs in **Table 3-1**, the cancer risks for PCE and TCE, even if totaled together, are substantially less that 10^{-4}. These cancer risks are calculated for a combined adult-child exposure lasting 30 years and incorporating exposure by ingestion, dermal contact, and inhalation of vapors generated by indoor water use, but not vapor intrusion. These cancer risks do not call the protectiveness of the remedy into question.

The HQ for exposure of a child to *cis*-1,2-DCE is calculated to be 1.2. The Reference Dose for *cis*-1,2-DCE is 0.002 mg/kg, which is based on dividing a Benchmark Dose for a 10% gain in kidney weight relative to body weight by an Uncertainty Factor of 3,000. Confidence in this RfD is rated as low. Finally, HQs do not represent numerical probabilities that a condition will occur, but merely the possibility that they may. This slight exceedance of an HQ of 1 therefore does not appear to represent a significant increase in the likelihood that this condition would occur.

TCE poses a special case in that its major critical effect is induction of fetal cardiac defects in pregnant women who may be exposed to TCE for a very short time period during their pregnancy. Confidence in this Reference Dose is high with a UF of 10. The 1.6 HQ presented in Table 5-2 is based on risk to the fetus of a pregnant adult rather than the child exposure. This hazard does not affect the protectiveness of the remedy because the remedy prevents the placement of groundwater wells where residents could come into contract with contaminated water.

Changes in Standard Default Exposure Factors. In 2014, the USEPA issued OSWER Directive 9200.1-120 which updated the Standard Default Exposure Factors originally issued in 1991 and used in risk assessments on the various units at the JBLM site. When the new SDEFs are substituted into risk equations for the ingestion and dermal contact pathways for exposure of residents to groundwater:

- Average Daily Intakes by ingestion for non-cancer effects for children decrease by 22%,
- Average Daily Intakes by ingestion for non-cancer effects for adults increase by 9.4%,
- Average Daily Intakes by dermal contact for non-cancer effects for children decrease by 47.8%,
- Average Daily Intakes by dermal contact for non-cancer effects for adults increase by 24.4%.

Thus, the potential for adverse non-cancer health effects decreases for children, but increases for adults.

For cancer exposures based on a combined child-adult exposure:

- Lifetime Average Daily Doses by ingestion decrease by 13.7%,
- Lifetime Average Daily Doses by dermal contact decrease by 18.2%.

Thus, the potential for cancer in the combined child-adult resident scenario decreases. These calculations are provided in **Tables 1** through **6** of this appendix.

Vapor Intrusion. The USEPA has released the Vapor Intrusion Screening Level (VISL) Calculator, a spreadsheet tool that allows calculation of risks from soil gas and groundwater concentrations (updated USEPA, 2015). This tool marks a shift from use of the Johnson and Ettinger model as a means of calculating VI risks. This tool was used to evaluate the vapor intrusion risk associated with two of the FYR sites, including the American Lake Garden Tract and Landfill 1. Neither of these sites was found to have unacceptable risks associated vapor intrusion.

Inhalation Risk Methods. In 2009, the EPA published Risk Assessment Guidance for Superfund (RAGS) - Part F, Supplemental Guidance for Inhalation Risk Assessment. Prior to publication of RAGS Part F, inhalation risks were estimated by calculating an acceptable daily intake or ADI in milligrams of chemical absorbed from air per kilogram of body weight of the receptor per day. The new guidance detailed a methodology for calculation of both cancer risks and non-cancer HQs from the air concentrations to which receptors were exposed. This change to risk estimates for inhalation exposures is not expected to call the protectiveness of the remedy into question. Changes in inhalation risks are summarized in **Table 7** and **8**.

Dermal Risk Methods. In 2004, the EPA published RAGS - Part E, Supplemental Guidance for Dermal Risk Assessment. RAGS Part E made a number of changes in dermal risk methodology, including:

- Provided updated dermal exposure assessment equations for the water pathway.

- Provided an updated table for screening COPCs from contaminants in water.

- Provided values for dermal absorption of ten chemicals from soil and recommended defaults for screening classes of organic compounds.

- Provided updated soil adherence values based on receptor activities.

- Updated dermal exposure parameters to be consistent with the 1997 Exposure Factors Handbook.

- Outlined a more complete uncertainty analysis section for dermal risk assessments.

Some of these changes have been superseded by the 2014 changes in SDEFs described earlier. The changes associated with RAGS Part E do not bring the protectiveness of the remedy into question.

Toxicity Hierarchy. In 2003, the EPA published the OSWER Directive 9285-7.53 Human Toxicity Values in Superfund Risk Assessments. This memorandum revised the hierarchy of the sources of toxicity values from the original hierarchy set out in RAGS Part B. Under the RAGS Part B hierarchy, the Health Effects Assessment Summary Tables (HEAST) were the main secondary source for toxicity values for chemicals not addressed in the EPA's IRIS. The HEAST tables ceased to be updated in 1997. Thus, information from that source was becoming dated. In addition, there were additional sources available, such as ATSDR, and state regulatory agencies were beginning to develop their own toxicity values with peer reviewing.

The new toxicity hierarchy was based on a principle of using the best science available for risk estimates. It established a hierarchy of three tiers:

- Tier 1- the EPA's IRIS

- Tier 2- the EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs)

- Tier 3- Other Toxicity Values –includes additional EPA and non-EPA sources of toxicity information with priority given to those sources that are most current, transparent, publicly available, and peer reviewed

The change in the toxicity hierarchy is not expected to call the protectiveness of the remedy into question.

Cancer Potency Adjustment for Early-Life Exposure Adjustments to Mutagenic Carcinogens. Carcinogens that operate by directly inducing mutations in deoxyribonucleic acid (DNA) may have greater cancer potency during periods of life when greater cell proliferation is occurring. For TCE, which is a mutagenic carcinogen, this increased potency is addressed by dividing the exposure into age bins and making an adjustment to the cancer toxicity value of:

- 10-fold for ages 0 - <2 years

- 3-fold for ages 2 - <16 years

- no adjustment for ages 16 years and older

This adjustment may increase the overall TCE cancer risk estimates by approximately two to three fold.

An alternative to ADAFs is used for the mutagenic carcinogen VC. For VC, an uncertainty factor of 2 is applied to the cancer toxicity values if the exposure includes a portion of time when increased rates of cell mitosis are expected. These changes in cancer potency are not sufficient to bring the protectiveness of the remedy into question.

Ecological Risk Assessment Guidance. In 1997, USEPA published the *Ecological Risk Assessment Guidance for Superfund* (USEPA, 1997), which details an eight step process for conducting ecological risk assessments. This guidance provides for a screening level ecological risk assessment (SLERA) in the first two steps. If the SLERA shows that significant risk does not exist, the process can be halted at this point. Otherwise, the remaining steps can be used to perform a full quantitative ecological risk assessment.

TABLE 1
Changes in Oral Non-Cancer Total Intake Factors

TIF = IR*EF*ED/(BW*ED)					
Exposure Factor	**Old Value**	**New Value**	**Units**	**% Change**	**Definition**
			Child		
IR_c	**1**	**0.78**	L/day	-22	Daily water ingestion rate, child
EF	350	350	days/yr		Exposure frequency[1]
ED_c	6	6	yr		Exposure duration, child
BW_c	15	15	kg		Bodyweight, child
$AT_{c\text{-}nc}$	2190	2190	days		Averaging time, 365days/yr*ED_c
$TIF_{c\text{-}nc}$	6.39E-02	4.99E-02		-22	% Change in Intake and Risk
			Adult		
IR_a	**2**	**2.5**	L/day	25	Daily water ingestion rate, adult
EF	350	350	days/yr		Exposure frequency[1]
ED_a	**24**	**20**	yr	-16.7	Exposure duration, adult
BW_a	**70**	**80**	kg	14.3	Bodyweight, adult
$AT_{a\text{-}nc}$	**8760**	**7300**	days	-16.7	Averaging time, 365days/yr*ED_a
$TIF_{a\text{-}nc}$	2.74E-02	3.00E-02		9.4	% Change in Intake and Risk

L/day = liters per day
cm^2 = square centimeter
hr = hour
days/yr = days per year
yr = year
kg = kilogram

TABLE 2
Changes in Dermal Non-Cancer Total Intake Factors

$$TIF_{nc} = IR*EF*ED/(BW*AT_{nc})$$

Exposure Factor	Old Value	New Value	Units	% Change	Definition
SA_c	**6600**	**6378**	cm^2	-3.4	Exposed surface area, child
ET_c	**1**	**0.54**	hr	-46.0	Exposure time in shower, child
EF	350	350	days/yr		Exposure frequency[1]
ED_c	6	6	yr		Exposure duration, child
BW_c	15	15	kg		Bodyweight, child
AT_{c-nc}	2190	2190	days		Averaging time, 365days/yr*ED_c
TIF_{c-nc}	4.22E+02	2.20E+02		-47.8	% Change in Intake and Risk
SA_a	**18000**	**20900**	cm^2	16.1	Exposed surface area,adult
ET_a	**0.58**	**0.71**	hr	22.4	Exposure time in shower, adult
EF	350	350	days/yr		Exposure frequency[1]
ED_a	**24**	**20**	yr	-16.7	Exposure duration, child
BW_a	**70**	**80**	kg	14.3	Bodyweight, child
AT_{a-nc}	**8760**	**7300**	days	-16.7	Averaging time, 365days/yr*ED_c
TIF_{a-nc}	1.43E+02	1.78E+02		24.4	% Change in Intake and Risk

L/day = liters per day
cm^2 = square centimeter
hr = hour
days/yr = days per year
yr = year
kg = kilogram

TABLE 3
Changes in Oral Cancer Total Intake Factors

$$TIF_{c/a\text{-}c} = (IR_c*ED_c/BW_c + IR_a*ED_a/BW_a)*EF/AT_c$$

Exposure Factor	Old Value	New Value	Units	% Change	Definition
Combined Child/Adult					
IR_c	**1**	**0.78**	L/day	-22	Daily water ingestion rate, child
ED_c	6	6	yr		Exposure duration, child
BW_c	15	15	kg		Bodyweight, child
IR_a	**2**	**2.5**	L/day	25	Daily water ingestion rate, adult
ED_a	**24**	**20**	yr	-16.7	Exposure duration, adult
BW_a	**70**	**80**	kg	14.3	Bodyweight, adult
EF	350	350	days/yr		Exposure frequency[1]
AT_c	25550	25550	days		Averaging time, 365days/yr*ED_a
$TIF_{c/a\text{-}c}$	1.49E-02	1.28E-02		-13.7	% Change in Intake and Risk

L/day = liters per day
cm^2 = square centimeter
hr = hour

days/yr = days per year
yr = year
kg = kilogram

TABLE 4
Changes in Dermal Cancer Total Intake Factors

$$TIF_{c/a\text{-}c} = (SA_c * ET_c * ED_c / BW_c + SA_a * ET_a * ED_a / BW_a) * EF / AT_c$$

Exposure Factor	Old Value	New Value	Units	% Change	Definition
SA_c	**6600**	**6378**	cm^2	-3.4	Exposed surface area, child
ET_c	**1**	**0.54**	hr	-46.0	Exposure time in shower, child
ED_c	6	6	yr		Exposure duration, child
BW_c	15	15	kg		Bodyweight, child
SA_a	**18000**	**20900**	cm^2	16.1	Exposed surface area, child
ET_c	**0.58**	**0.71**	hr	22.4	Exposure time in shower, child
ED_c	**24**	**20**	yr	-16.7	Exposure duration, child
BW_a	**70**	**80**	kg	14.3	Bodyweight, child
EF	350	350	days/yr		Exposure frequency[1]
$AT_{c/a\text{-}c}$	25550	25550	days		Averaging time, 365days/yr*ED_c
$TIF_{a\text{-}nc}$	8.52E+01	6.97E+01		-18.2	% Change in Intake and Risk

L/day = liters per day
cm^2 = square centimeter
hr = hour
days/yr = days per year
yr = year
kg = kilogram

Table 5
Changes in Oral Reference Doses

Chemical of Concern	Reference Dose		Source	Change in risk?
	1990 BLRA	Current FYR		
Tetrachloroethene	-	6.0E-03	IRIS	Increase
Trichloroethene	7.4E-03	5.0E-04	IRIS	Increase
cis -1,2-Dichloroethene	2.0E-02	2.0E-03	IRIS	Increase
Vinyl chloride	1.0E-03	3.0E-03	IRIS	Decrease
1,1-Dichloroethene	-	5.0E-02	IRIS	Increase
1,1,1-Trichloroethane	9.0E-02	2.0E+00	IRIS	Decrease
Chlordane	-	5.0E-04	IRIS	Increase
Benzo(a)pyrene	-	-		
Benzo(a)anthracene	-	-		
Benzo(b)fluoranthene	-	-		
Benzo(k)fluoranthene	-	-		
Chrysene	-	-		

Notes:
Reference Doses presented in units of milligrams of chemical per kilogram of body weight per day.
FYR = Five Year Review
BLRA = Baseline Risk Assessment
IRIS = Integrated Risk Information System
NA = No value available

Table 6
Changes in Oral Cancer Slope Factors

Chemical of Concern	Oral Cancer Slope Factor		Source	Effect on Risk
	1990 BLRA	Current FYR		
Tetrachloroethene	-	2.1E-03	IRIS	Increase
Trichloroethene	1.1E-02	4.5E-02	IRIS	Increase
cis -1,2-Dichloroethene	-	-		
Vinyl chloride	2.3E+00	7.2E-01	IRIS	Decrease
1,1-Dichloroethene	-	-		
1,1,1-Trichloroethane	-	-		
Chlordane	-	3.5E-01	IRIS	Increase
Benzo(a)pyrene	-	7.3E+00	IRIS	Increase
Benzo(a)anthracene	-	7.3E-01	TEQ	Increase
Benzo(b)fluoranthene	-	7.3E-01	TEQ	Increase
Benzo(k)fluoranthene	-	7.3E-02	TEQ	Increase
Chrysene	-	7.3E-03	TEQ	Increase

Notes:
Cancer Slope Factors presented as per (milligrams of chemical per kilogram of body weight per day).
FYR = Five Year Review
BLRA = Baseline Risk Assessment
NA = Not available
IRIS = Integrated Risk Information System

Table 7
Changes in Inhalation Unit Risks

Chemical	Inhalation Unit Risks		Source	Effect on Risk
	1990 BLRA	Current FYR		
Tetrachloroethene	-	2.6E-07	IRIS	Increase
Trichloroethene	-	4.1E-06	IRIS	Increase
cis -1,2-Dichloroethene	-			
Vinyl chloride	-	4.4E-06	IRIS	Increase
1,1-Dichloroethene	-			
1,1,1-Trichloroethane	-			
Chlordane	-	1.0E-04	IRIS	Increase
Benzo(a)pyrene	-	1.1E-03	IRIS	Increase
Benzo(a)anthracene	-	1.1E-04	TEQ	Increase
Benzo(b)fluoranthene	-	1.1E-04	TEQ	Increase
Benzo(k)fluoranthene	-	1.1E-04	TEQ	Increase
Chrysene	-	1.1E-05	TEQ	Increase

Notes:
$(\mu g/m^3)^{-1}$ = per (microgram of chemical per cubic meter of air)
NA = Not available
IRIS = Integrated Risk Information System

Table 8
Changes in Inhalation Reference Concentrations

Chemical of Concern	Reference Concentrations		Source	Change in risk?
	1990 BLRA	Current FYR		
Tetrtachloroethene	-	4.0E-02	IRIS	Increase
Trichloroethene	-	2.0E-03	IRIS	Increase
cis -1,2-Dichloroethene	-	-		
Vinyl chloride	-	1.0E-01	IRIS	Increase
1,1-Dichloroethene	-	2.0E-01	IRIS	Increase
1,1,1-Trichloroethane	3.0E+00	5.0E+00	IRIS	Decrease
Chlordane	-	1.0E-04	IRIS	Increase
Benzo(a)pyrene	-	-		
Benzo(a)anthracene	-	-		
Benzo(b)fluoranthene	-	-		
Benzo(k)fluoranthene	-	-		
Chrysene	-	-		

Notes
Reference Concentrations presented in units of milligrams of chemical per cubic meter of air.
[1] 0.3 mg/kg/day inhalation RfDof 0.3 mg/kg/day converted to RfC
[2] ATSDR MRL of 0.005 ppm TCE = 0.027 mg/m^3
FYR = Five Year Review
BLRA = Baseline Risk Assessment
IRIS = Integrated Risk Information System
NA = No value available